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THE PATENTS AND DESIGNS ACT, 1907.

THIS new Act consolidates the enactments relating to Patents for Inventions and the Registration of Designs and certain enactments relating to Trade Marks, all previous Acts relating to these matters being repealed. The Act contains many amendments which will be of the greatest value to *bona fide* inventors, and it also contains new provisions which protect the public from being blackmailed by fraudulent monopolists.

Under previous Patents Acts, every application for a patent was examined for the purpose of ascertaining whether the invention claimed had been wholly or in part claimed or described in any complete specification published before the date of the application, the search extending back not less than fifty years. Since, however, in the case of applications made with a provisional specification the filing of the complete specification might be delayed for fifteen months, there might be many anticipations which would not be reported by the Examiner because all the prior complete specifications had not been published. The new Act now extends the field of investigation to include prior cases published subsequently to an application. As a consequence of this, the patentee may have anticipations reported to him after his complete specification has been accepted, or even after a patent has been granted to him. The patentee will be required to amend his specification to avoid these anticipations, or, if he refuses to do so, references to the anticipating cases will be inserted in his specification by the Comptroller, by way of notice to the public.

Still further to protect the public against the bogus patentee, ample power to revoke patents has been given to the Comptroller. Any person who would be entitled to oppose the grant of a patent, may, within two years from the date of the patent, apply to the Comptroller for an order revoking the patent on any one or more of the grounds on which the grant of the patent might have been opposed.

The Patents Law, as it stands at present, gives no power to refuse a patent, even though complete anticipations have been found. The Comptroller can only insert references to the anticipating cases. When the new Act comes into force, on January 1st next year, the Comptroller will have power to refuse to grant a patent when he is satisfied that the invention has been wholly and specifically claimed in any specification to which the investigation has extended. This is an important amendment, bringing our Patents Law into line with that of great industrial countries like the United States and Germany, and will, no doubt, do much to enhance the saleability of patents for genuine inventions.

In the new Act, a valuable addition has been made to the grounds on which the grant of a patent can be opposed, namely, the ground that the nature of the invention or the manner in which it is to be performed is not sufficiently or fairly described and ascertained in the complete specification. The procedure in the Comptroller's Court has also been greatly improved. Witnesses can now be examined and cross-examined on oath. For lack of this power in the past, much valuable evidence which would have helped the Comptroller to arrive at a correct decision on oppositions to the grant of patents has been lost.

The patent of addition which has been obtainable under German and other foreign patents law, will now be available to the British inventor. It is provided in the new Act that a patentee may obtain a patent of addition for an improvement on an existing patent. No renewal fees are payable on the patent of addition, which is terminable at the same date as the principal patent.

Important provisions are made for the restoration of lapsed patents. Formerly a valuable patent might be lost if through an oversight the patentee failed to pay the renewal fee in time. A patent thus allowed to lapse could only be restored by Act of Parliament. In future the Comptroller will have power to restore such patents.

The procedure for obtaining compulsory licences has also been greatly simplified.

Perhaps the greatest innovation in the new Act is the revocation of patents worked outside the United Kingdom. This section will, no doubt, lead to a considerable industrial upheaval. Patented articles which have hitherto been manufactured mainly or exclusively abroad, will now have to be manufactured in this country, or the patents may be revoked.

It will be interesting to see what effect this will have on the price of patented articles. It has been characterised as a crude form of protection, and is, therefore, a measure that was not to be expected from a Free Trade Minister. Indirect benefits may, however, result.

By Sec. 33 of the new Act, an innocent infringer of a patent is exempted from liability for damages. The marking of an article with the word "patent," "patented" or the like, is not considered to be sufficient notification of the existence of a patent, unless the number and year of the patent is given.

When an extension of the term of a patent is required in the case of inventions taking longer than 14 years to develop, it is necessary under the present Patents Law to apply to the Privy Council. The procedure is cumbersome and expensive. This is greatly simplified under the new Act. The patentee will in future apply to the Court presided over by a judge specially appointed to try patent cases. This Court may grant extensions of seven or fourteen years, and may even grant a new patent. In the latter case it would appear that a patent may be extended indefinitely, for 100 years if necessary, so that complete provision is now made to protect inventions required for such purposes as the 12-mile bore-hole contemplated by Mr. Parsons.

There are many other valuable new provisions in the Consolidated Patents and Designs Act, 1907, which we have not space to discuss; they are summarised in an article elsewhere in this issue. On the whole, the Act does great credit to the President of the Board of Trade, and will remedy most of the real grievances of inventors.

Equalisation and Overtime.

Equalisation, in one form or another, has of necessity severely taxed the brain power of the human race. Inasmuch as the universe knows nothing of straight-line laws of operation, but proceeds along only imperfectly understood cyclical alternations, both man and the lower animals practise methods of hoarding food stuffs. This instinctive action has become in its final developments the keynote for a great part of the work of the engineer. Railways, steamships, granaries and elevators all tend to reduce the acutest phases of food scarcity. Reservoirs maintain water supplies during arid months. Gas works have large gas-holders of varying storage capacity, designed to maintain an even rate of production of a commodity whose chief consumption is spread over a part only of the day.

A striving after equalisation is bulking largely in many branches of the engineer's work. Everywhere the demand is for the continuous in place of the intermittent. Continuous processes of steel production have attracted attention. The elimination of the peak-load is the aim of those responsible for the operation of electricity supply works; hence the faith of those who still cling to the possibilities of the secondary battery; hence also thermal storage to assist the boiler house, or the fly-wheel converter sets to level out heavy momentary overloads on the main generators. The intermittent is realised as undesirable in every branch of engineering, and reserve funds for the equalisation of dividends are regarded as sound finance.

The technical training of an engineer therefore renders him especially alert when questions of equalisation arise in other spheres of life. With much he must perforce sympathise when abstract academic questions are propounded. But despite his environment and technical ideals, he cannot but realise that when he passes from the mechanical sphere into those spheres beyond the control of either scientist or politician, the demands for equalisation everywhere reiterated are incapable of being met. The cry for equalisations of an economic nature cannot be satisfied. The machine which is demanded by this or that militant section of the community cannot be made. The fly-wheel has its limitations, and while the fly-wheel does help to meet fluctuations, the energy supplied to the rim of the fly-wheel has to be controlled in the case of the reciprocating engine by varying the supply of steam to the engine. The governor prevents racing by cutting off the steam at an earlier period in the stroke during times of continued light load, and during times of continued overload it cuts off the admission at a later period, in order to prevent stoppage. In manufacturing conditions, stores of raw, partially finished or finished material act as a fly-wheel; but actual production is subject to a variable cut-off by reason of the extreme fluctuations of supply and demand. The ideals of one school of politicians conceive a social machine without a governor. For years past trade-union officials have intrigued against overtime, and we have just had the declaration of the Trade Union Congress in favour of suppression of systematic overtime by the State.

We do not quite apprehend what is meant by systematic overtime. Pursuing our steam engine analogy, we assume that their demand means that when the available energy of the fly-wheel has been absorbed—*i.e.*, when stocks are exhausted—no automatic expansion valve shall come into play to meet a period of overload. Instead, the trade-union demand is that more labour shall be employed, *i.e.*, another engine shall be started up. The delegate who advanced simple arithmetical estimates by way of argument—so many men work so many hours overtime, if this were suppressed there would be so many more men employed full time—is more to be commended for his plausibility than for his common sense. Overtime is an unavoidable necessity, bringing to the employer a proportion of profit in no way commensurate with the increased turn-over. Wages are

paid at an advanced rate, while the output per unit of time is reduced. It is more advantageous to the employer to have his output constant and only full time worked.

Overtime in industrial operations is akin to the special demands made at times on troops in the field. Should one side fail to respond to those demands, arising under abnormal circumstances, the victory would go to the side that was prepared to make an extra sacrifice. So in commercial spheres, production and consumption can never balance until periods of sunshine and inches of rainfall are as constant as the threads of a Whitworth bolt, until the yield per acre of the world's cultivable surface is a constant quantity, until agricultural science has reached the stage that fertilisation maintains the productive power of the soil absolutely constant. Further, death rates and birth rates would have to balance, the amount of machinery to be produced would have to balance exactly wear and tear, and metallurgical operations must neither be depressed by slow exhaustions of rich ore, nor convulsed by new discoveries of ore or methods of treatment. When matters have reached such an incomprehensible dead level the State may say "So many hours shall ye work and no longer." To demand artificial restriction of the capability to meet every varying condition becomes a tampering with the governor gear. True, supply and demand, which control output, act irregularly; but unless all engaged in an industry recognise the fluctuations to which it is liable, and meet the peaks of such fluctuations by their voluntary extra exertions, commercial supremacy must pass to those nations that possess adequate elasticity. Given success to this demand for the abolition of overtime, the next outcry would be for the abolition of half or three-quarter time when trade fell off. So-called reformers can, perhaps, tell us what will happen then. For our own part, we would commend the savings bank as the surer remedy, the earnings of the busy period meeting the demands of the slack period. After all, this is merely a modification of the wisdom of the squirrel, or the ant, or the bee, save that these humbler members of creation do not garner at the rate of "time and a quarter" or "time and a half" in the hours employed in food gathering beyond the immediate daily need.

Electrification of Trunk Line Railways.

While we are making time, our American *confrères* are going ahead. There is, it is true, no doubt that our great railway companies have their eyes on electric traction as a possible means of reducing the congestion of their suburban traffic, but, with the exception of the Brighton and the L. and N.W. Companies, we hear of no active steps to adopt that remedy. In the States, on the other hand, the New York railway companies have not hesitated to carry out huge schemes of electrification, undeterred by the conflict between D.C. and A.C. systems—in fact, they are using both—while the possibility of extending the electric system beyond the suburbs to the main lines has been seriously discussed. Granted that an immediate change is impossible: that conditions are too unsettled for so vast an upheaval: and that, as was pointed out in our pages last week, the electrical manufacturing companies could not possibly cope with the enormous amount of work that would be suddenly thrown upon them: these facts, however, do not materially affect the main question. No sane man would propose anything in the nature of an abrupt change—it must be gradual; during the process, evolution will be at work, and the best system will force its way to the front; and, lastly, it is not unlikely that when the railway companies commence in earnest to electrify, as they now build their own steam locomotives, so they will then build their own electrical equipments.

At all events, the conversion of the American railway directors appears to have already made good progress, for we learn from the *Electrical World* that the Southern Pacific Co., one of the lines controlled by Mr. Harriman, has appointed Mr. Frank J. Sprague, together with Mr. A. H. Babcock (the company's electrical engineer), to inquire into the feasibility of electrifying part of the Sacramento division of the railway system, and to prepare a general plan of electric traction. The section of line in question is described as one of vital importance; it is also one of exceptional difficulty, for it connects Rocklin on the west, and Sparks on the east of the Sierra Nevada Mountains, a distance of 136 miles, of single track, very tortuous, and afflicted with grades from 1½ to 2½ per cent. The summit is 7,000 ft. above sea level, and all eastbound freight has to be raised to that height in a stretch of 83 miles of railway. Moreover, there are over 31 miles of snowshed and rock tunnel on this section, and the climatic conditions in winter are very severe.

Even with the best types of oil-burning locomotives, the heavy traffic is at present maintained only with difficulty, and the road is taxed to its utmost limit. Mr. Harriman is known to believe that the increase of the carrying capacity of trunk lines can only be solved with the aid of electric traction, and it would seem that he has set the electrical engineers this exceptionally hard nut to crack with intent to test the utmost capabilities of electricity. Not for the first time does the electric motor come forward to accomplish a task which is too hard for steam. It will be noticed that the section under consideration is in the neighbourhood of San Francisco, and within range of the magnificent water powers of the Sierras, which have already afforded scope for extraordinary feats of electrical transmission of power. The greatest interest attaches to this important step.

Mr. Sprague, who has hitherto been a strong advocate of the direct-current third-rail system, states that he approaches the subject with an open mind; he has first to solve the question whether the cost of electric equipment would be justified by the results—of which, we think, there can be little doubt—and he has already commenced work in collaboration with Mr. Babcock.

Copper.

The steady decline in the price of standard copper has given rise to a variety of theories as to the real position of the market. The reduction, after a long delay, of the price of electrolytic was a concession on the part of the producers, leading to the conclusion that they saw no prospect of longer maintaining the high prices. On the other hand, we hear constantly that the consumer is short, and that the rate of consumption has not diminished. One of the principal market circulars, that of Messrs. Vivian, Younger & Bond, gives the information that the large producers in America and Europe have been holding stocks, and have accumulated a considerable quantity, being followed in this respect by the Japanese. It is noticeable that Australia is not included in the above list. The deduction that the Australians had been selling on a market artificially sustained by the States, is, perhaps, hardly justified, but the omission distinctly suggests it.

The position of the opening months of the year appears, therefore, to be practically reversed. Whereas until recently the consumer was being forced to buy at rates enhanced by the activity of speculation, and the withholding of supplies, he now finds himself with a declining market apparently backed by stocks which have been allowed to accumulate. In face of the constant decline, he naturally waits for the price to go lower still before disturbing the market by anything like large purchases. This position is commented on by the leading trade journals. The *Financial Times* expresses it as "The recent decline, while it has apparently induced some of the smaller purchasers to reconsider their position, has not, however, so far caused the large consumers to abandon their previous attitude." In the same article, an extract from the *Boston News Bureau* states that "there are no negotiations in progress between the large producers and the large consumers looking to the establishment of a mutually satisfactory price level at which a large business will be done. The big

producers are not standing together by agreement, and neither are the large consumers." It is easy, therefore, to understand the reluctance of the unsupported consumer to disturb a market which may, and often does, on very slight excuse, jump in either direction, with the chance of being held at a high price by the action of a few influential producers. Whichever side manages to effect a fresh combination the earlier will have command of the situation. Recent indications would point to the fact that the producer has the better facilities for, at any rate, temporary co-operation than the consumer. According to the journal above quoted, it is contended that if consumers stand out of the market much longer there will be a curtailment of production. The figures quoted in support of this theory do not, however, appear to indicate more than a fluctuation in output due to natural causes. If anything like large stocks have been accumulated there will be a tendency, in view of the present prices, to economise on production for the time being, but the real effect of this would hardly begin to be felt at present.

The policy of the consumers is evidently, if anything like agreement is possible, to continue buying in small quantities during the period of depressed prices, retiring from the market at once as soon as it shows an upward tendency. Continued retention of orders, followed by sudden activity when the price is supposed to have touched bottom, will naturally be followed by a sharp rise which may once more be artificially sustained.

Labour Agitation in Berlin.

The electrical machinery erectors have decided, at what is stated to have been a mass meeting held in Berlin, at once to start a wages agitation. Apparently the scheme has been under consideration for some time past, as a programme was approved at the meeting for submission to the electrical employers in the course of a few days. The principal demands put forward are that the working day shall amount to nine hours, and terminate by 6 p.m. at the latest, closing one hour earlier on Saturdays and two hours earlier before holidays; and that when there is a scarcity of work the length of the working day shall be reduced instead of men being dismissed. It is also submitted that the minimum wage for erectors should be 7·8d. per hour, with 6d. per hour for assistants, and that an extra payment of 6d. per hour should be made for carrying out work involving danger. The erectors further ask that overtime which cannot be avoided shall be paid for at an increase of 25 per cent., night work at an advance of 50 per cent., and work on Sundays and holidays at 75 per cent. extra. Double pay is demanded for work in mines, and it is proposed that piece work be abolished. It is also asked that in the case of protracted works carried out abroad, an opportunity and funds should be given for enabling erectors to pay a visit to their families.

Electrical Production of Steel.

The works of the Rochling Iron and Steel Co., of Volklingen-on-the-Saar, where the electrical production of steel has been in progress for about a year, were recently inspected by a number of interested persons representing various branches of the iron and steel industry in Germany, Switzerland, Belgium, Russia and Japan. The special object of the visit was to see the latest type of furnace for a charge of 3 tons, which has been in uninterrupted working for several weeks, and which purifies the liquid charge from the basic converter to traces of sulphur and phosphorus. The new furnace is based upon a combination of the original kind of Kjellin furnace with various improvements conceived and introduced by Messrs. Rochling and Rodenhauser. It is stated in circles associated with the Siemens & Halske Co. that a company is shortly to be formed to promote the use of the improved type of furnace.

FIRE AND EXPLOSION-PROOF ELECTRICAL MINING MACHINERY.

By "GLUCKAUF."

There is ample proof that, when properly installed, electric motors and switchgear are perfectly safe, even in the most fiery mines; at the same time grave risks of explosion are incurred by the installation of unsuitable electrical machinery in mines liable to "fire-damp."

Switchgear is, as a rule, the worst offender, as there seems to be a general aversion to paying for the controlling gear some 35 to 50 per cent. of the price of the motors.

Many contractors pin their faith in (so-called) gas-tight switchgear, but in the writer's opinion such switchgear is quite unsuitable for mining work. A defective gland or cable packing, a worn controller spindle, &c., may admit fire-damp to the inside of the switch or controller case, without the most careful examination revealing the defect. The writer has seen several instances where, owing to such defects, gas has leaked in; and on the next time of switching "on" or "off," the switch case has been broken by the explosion. In two cases this occurred in a position where fire-damp was quite unsuspected.

In this connection it must not be overlooked that many of the light gases, such as methane, hydrogen, acetylene, &c., will enter a switchbox which is water and even air-tight. For instance, ordinary gas fittings, that are quite suitable for coal gas lighting, are not suitable for acetylene, as the joints, taps, &c., are not ground accurately enough to prevent leakage of the acetylene gas. The velocity with which a gas will diffuse through a porous material or an imperfect joint, varies directly as the difference in pressure on the two sides of the opening and inversely as the square root of the density of the gas. It follows, therefore, that the mixture that diffuses into the switch case may differ from, and possibly be more explosive than, the mixture on the outside of the case.

All underground switchgear should therefore be of the oil-immersed type, all contacts being under oil. The same also applies to controllers, and these should be arranged in a horizontal position, so that there is no need to have the joint of the controller lid oil-tight, this joint being kept above the surface of the oil. This allows the controller contacts to be readily inspected without emptying the oil from the case.

Apart from the explosion-proof advantages of such oil-immersed switchgear, there is the additional advantage that the oscillations when switching "on" and "off" cables and transformers, &c., are greatly reduced as compared with those occurring with air-break switchgear, and the risk of cables being punctured is thus reduced to a minimum. Careful oscillograph experiments have amply proved this point. If oil switches are fitted with overload relays, and for high-tension work such relays are certainly far preferable to fuses, the relays should be totally oil-immersed, not only as a protection to the insulation, but also as a safeguard against dust and dirt affecting the working of the relay.

Such relays should be capable of being set or adjusted without removing the oil; in fact, all parts of either an oil switch or a controller should be readily accessible by simply lifting the gear out of its oil case, or, better still, merely lowering the oil case, and thus leaving all connections undisturbed. The method provided for drawing off the oil from the switch case should not be such that it can be tampered with, otherwise pitmen may find this a ready way to obtain oil for various odd jobs.

Motors.—The three-phase system is now almost universal for underground work, as continuous-current motors, no matter how well designed, are always liable to sparking and even "flashing over" on the commutator, especially if overloaded. To avoid any serious sparking three-phase motors for mining work should always have at least three brushes per slip-ring as obviously otherwise a defective brush-contact or broken brush-spring might cause very serious arcs to be produced. There is no difficulty at all in designing three-phase motors capable of exerting a starting torque equal to 2½ times the normal full load torque, which is ample for any haulage motor. The most trying duty a

haulage motor has to face is when several wagons or tubs become derailed, and such a motor will be quite equal to dealing with any derailment. After all a steam haulage engine can only give a maximum torque equal to piston area multiplied by steam pressure.

Motors working in down cast shafts are usually open type machines as there is no risk from explosion, such motors may also be used in other portions of the pit provided that a good supply of fresh air from the "down cast" shaft can circulate through the motor house so as to avoid any chance of explosive gas collecting in it.

In "return" air ways and "up cast" shafts, however, there is generally from 3 to 6 per cent. of gas always present, and here the motors must be properly protected. Some makers merely enclose the slip-rings, but this would obviously not afford any protection in the event of, say, a stator coil burning out. As a matter of fact, such breakdowns are usually traceable to the vibration from the gearing, so that a good flexible coupling with rubber (a spring coupling will not absorb the vibration nearly so well as rubber, a fact well proved in cycle and motor engineering) blocks should be used, so as to avoid undue vibration being transmitted to the motor. In many instances totally enclosed motors are used, so designed as to allow a fresh air circulation, and thus avoid any explosive mixture collecting in the motor case.

The most recent practice is to so design the motors, that in the event of any explosion taking place inside the motor casing, the flame is prevented from reaching the outside by a modification of the safety lamp principle.

The motor casing, end shields, &c., are made strong enough to withstand the pressure due to an explosion inside; the air-space being reduced to a minimum so that the cubical capacity, and hence the volume of gas that can collect in the motor, is kept as small as possible. A series of long, narrow slots are provided which prevent the explosion wave igniting the outside gas, the cooling surface of the slots lowering the temperature below the ignition point, so that all danger of the gas in the mine being fired by an explosion inside the motor is avoided. Experiments clearly prove that such motors can work safely for lengthy periods in an explosive mixture much above the limit that would be allowed in any mine. They should be blown through with compressed air at least once every day, to prevent any coal dust stopping up the openings. Coal dust in a finely divided state and dry condition is in itself explosive, and should always be removed from any motor.

Galloway has shown that less than 2 per cent. of fire-damp is explosive when mixed with incombustible mineral dust. As stated above, the motor case (and also the fastening of the inspection covers) must be capable of withstanding any explosion inside.

Taking fire-damp as being mostly carburetted hydrogen (CH_4) the mixture giving the maximum explosive force will be 10 volumes of air to 1 volume of gas, the explosion pressure being 210 lb. per sq. in., which, of course, the motor case must withstand safely.

The following table (due to Eithner) gives the explosive limits of various gases mixed (by volume) with air :—

	Lower limit.	Upper limit.	Explosive range.
Carbon monoxide... ...	16·5%	74·95%	58·45%
Hydrogen	9·45%	66·40%	57·95%
Water gas (uncarburetted)	12·40%	66·75%	54·35%
Acetylene	3·35%	52·30%	48·95%
Coal gas	7·9%	19·10%	11·20%
Ethylene	4·10%	14·60%	10·50%
Methane	6·10%	12·80%	6·70%

The explosive limit and range of explosibility are influenced by various factors, such as the pressure, manner of ignition, amount of aqueous vapour present, &c., but the above figures are those obtained under equal conditions, and are therefore comparable one with the other. Aqueous vapour reduces the explosive range, rise in temperature (unless accompanied by an increase in the proportion of aqueous vapour present) increases it.

The lower explosive limit denotes the lowest percentage of the gas with a mixture of air which will explode when a light or spark is applied.

If the percentage of combustible gas in the mixture exceeds the upper explosive limit it will not explode when a light is applied, but will burn at the open mouth of a vessel as it comes in contact with the outer air, there being no tendency to fire back.

Dr. Clowes gives somewhat different values to Eithner, due no doubt to the experiments being made under different conditions. He gives—

	Lower limit.	Upper limit.
Hydrogen...	5	72
Water gas...	9	55
Coal gas (Nottingham)	6—9	29—22
Methane	5—6	13—11

Fire-damp is more or less pure methane (or carburetted hydrogen CH_4), but its exact composition varies with the nature of the coal (bituminous, &c.) seam, ethane C_2H_6, butane C_4H_{10} and other gases being frequently present.

It is well to be on the safe side, and assume that above 4 per cent. of gas is explosive. While there are many cases where open motors placed in well-ventilated positions are perfectly safe, and need only have slip rings (or commutators if continuous current motors) protected from dust, it is certainly advisable to install explosion-proof machines in return air ways and other places very liable to be fiery. Enclosed motors are very apt to draw in gas, especially when the bearings are worn, due to the partial vacuum in the motor-case when the machine cools down after use. Should this gas fire the flame would get to the outside by blowing off the inspection lids or covers. This point has been dealt with somewhat fully, as it is usually totally ignored in text-books. The ordinary "Davy" lamp will not detect less than 2 per cent. of fire-damp.

Motor Controlling Resistances.—These should be very amply rated so as to be capable of taking heavy overloads (especially for haulage motors) without overheating. They should be oil immersed, oil pumps of ample size being provided for circulating the oil through the radiators or coolers. Such resistances are protected by the oil from corrosion by contact with air when heated, and, further, should a resistance grid break, any sparking would be rendered harmless by the oil. The quantity of cooling oil allowed should be carefully checked, as by cutting down this item contractors can considerably reduce their tender prices to the disadvantage of the colliery owner, this point being often overlooked. Great care should be taken with the oil-cooling pipework, joints being as few in number as possible and made with lead wire, as the warm oil will soon soften any red or white lead jointing material, and thus cause oil leakage at the joints.

Transformers.—Oil-cooled transformers should always be used for underground mining work, as if air cooled they are very liable to insulation troubles due to excessive damp, and the burn out of any of the windings would be most dangerous if fire-damp were present. Oil-cooled transformers in the larger sizes are much cheaper than air cooled, especially if the transformers have water-cooling coils in the upper part of the cases. The quantity of oil should be ample to avoid a final temperature, when running continuously at full-load, of more than 160° to 170° F., or 70° C. to 76° C. being reached. The usual Continental limit of 50° to 60° C. (temperature rise) assumes a maximum air temperature of 35° C., thus giving a final temperature of 85° C. (or 185° F.), which is rather high for mining work, although the air temperature is seldom so high as 35° C. (95° F.).

Transformer and Switch Oil.—The use of oil insulation is regarded by many as introducing grave fire risks. This fear is, however, unfounded. No oil can become a fuel unless heated to or above its flash point, which is far above the temperature that any transformer should ever reach. The flash test of any insulating oil should not be below 185° C. (365° F.), the burning test being at least 200° C. (392° F.). Most samples have a flash point as high as 200° C. It is very unlikely that a fault in the winding would cause overheating sufficient to raise the temperature to, say, 180° C. without opening the automatic switches.

A temperature indicator of the fire alarm thermometer type could be placed in the upper portion of the oil case as an additional safeguard. When heated to about boiling point, oil will give off dense clouds of smoke, and this in a

mine would certainly be dangerous, but could be easily guarded against by use of such a thermal alarm.

Insulation oil should be pure unmixed mineral oil obtained by fractional distillation from petroleum, and not chemically treated in any way whatever.

Transformer oil should be fairly light in colour and as fluid as possible; switch oil may be darker and a little more viscous.

The oil must contain no trace of either acid or alkali, and all moisture must be got rid of by carefully heating to about 130° C. before using. Such oil can be obtained at from 15d. to 18d. per gallon.

Oil switches should have the oil removed and filtered occasionally, the switch cases being thoroughly cleansed before being refilled.

In oil switches the constant arcing tends to blacken the oil by forming a carbon deposit which should be got rid of from time to time by filteration. Oil cases should be very well made, the cases being carefully jointed and the joints well caulked, as oil will work through the joint otherwise. Soldered joints are not satisfactory, as they generally give way and cause trouble by leakage after a little time in use.

From the above remarks it is evident that mining motors and switchgear must be carefully chosen, as they have to work under quite different conditions to those generally met with; and they can hardly be too strongly designed in view of the rough and heavy service they have to withstand. The extensive introduction of electricity into mines that has taken place in recent years amply proves that when the plant is carefully selected it is not only perfectly safe and satisfactory, but also a good paying investment, as it tends to considerably increase the output of the pit.

REVIEW OF THE L.G.B. DEPARTMENTAL COMMITTEE'S REPORT RELATING TO ELECTRICITY SUPPLY UNDERTAKINGS.

PART VI. (*Conclusion.*)

L.G.B. Standard Form of Abstract of Electricity Accounts for Publication by Local Authorities.

The form of revenue account (II) is most disappointing. From the businesslike proposals of the Committee, indicating as they do that much consideration and time was spent thereon, we should naturally expect to find such proposals epitomised in an improved form to that at present in use, but the form of revenue account as set out in the report indicates hasty consideration, lack of technical knowledge, disregard to existing statutory requirements and hopeless confusion of ideas.

In the first place, even a slight technical knowledge would have prevented the glaring error of specifying "6. Wages at *static* transformer stations," and "7. (*a*) Repairs and maintenance *static* transformer stations."

Disregard to statutory requirements is evinced by the introduction of repairs and maintenance to "(*d*) motors," and "(*e*) Stoves and fittings, including wiring installations," into cost of "Distribution of electricity," when the L.C.C. General Powers Bill, 1906, distinctly ordains that the income and expenditure on account of these items must be shown separately in the abstract of accounts.

Although "boiler fuel and power" is clearly stated as the first item of expenditure, hastiness is shown in making provision for only "(*a*) coals, &c.," and "(*b*) power derived from refuse destructors, &c." when the inclusion of (*c*) power purchased, &c., would have indicated that the Committee had been alive to the possibilities of the adoption of practical bulk supply systems, not only in the greater London area, but also in the provinces.

The hopeless confusion of this account is apparent when it is noticed that "minimum charges" is omitted from the "Sale of electricity;" no provision is made for the *quantity* of current sold; and although departmental supplies of current must be shown, this differentiation is not required when dealing with "works executed for customers and goods sold." On the debit side we find salaries in five distinct places which is quite unnecessary, and many of the definitions are absurdly long.

We fail to understand the meaning of the foot note "*1 to 7. Transforming at generating stations is to be treated as generation; transforming elsewhere, as distribution." If the *cost* of transforming only is intended, we consider the foot note unnecessary as "(3) Wages at works" and "(4) Repairs and maintenance." "(*b*) Engines, boilers, machinery and plant" includes such cost at the generating station and "(6) Wages at *static* transformer stations," and "(7) Repairs and maintenance (*a*) *static* transformer stations" includes transforming in distribution costs. But if the *cost of transformation* is intended, and we rather think a furtive idea to this effect lurked in the brains of the compilers of this form of account, then no provision has been made for the inclusion of the same. It is quite feasible, and probably the more accurate system of accounting, to charge the whole of the units generated to generation, distribution and management, in the proper proportions debitable thereto at running cost, and if the L.G.B. Committee intend this revision in the footnote referred to, we think it will be the means of drawing attention to a source of considerable unnecessary waste of energy by many undertakings, and greater efforts would be made by engineers and committees to reduce this expenditure if stated annually in the accounts in terms of £ s. d.

We consider that this account should be a true record of the expenditure and income on account of the supply of energy only, and that all foreign matter should be treated separately, and suggest that the following suggestions should have consideration in the proper quarter before the proposals contained in the report become obligatory.

Dr.

1. Boiler fuel and power.—(*a*) — Tons — cwt. — qr. — Coal, including dues, carriage unloading, &c.; (*b*)—lbs. — Steam from refuse destructors, &c.; or (*b*)—Units generated from destructors, &c.; (*c*)—Units, power purchased.

If the recommendation embodied in paragraph 76 is to be practicable, these particulars are necessary for purposes of comparison.

2. (*a*) Running stores; (*b*) water.

There is nothing more ludicrous in the present form of accounts than the formula "oil, waste, water and engine room stores." The boiler house is completely overlooked, and in most engine rooms waste is never used. Surely "stores" or "running stores" is sufficiently comprehensive to ensure correct allocation. It is, for purposes of comparison, desirable to separate "water" from "stores."

3. Wages at works.—Salaries should not be included. The station superintendent or resident engineer is of sufficient importance to be included in the management staff, and, with undertakings whose magnitude does not admit of the employment of a constructional engineer, part of the time of the former official is spent in supervising extensions, and is chargeable in the general charges specified in paragraph 53; and as these general charges are creditable to management, it is evident that the debit should be made to the same account.

4. Repairs and maintenance, viz.:—(*a*) Buildings; (*b*) Engines, boilers, machinery and plant.

We prefer the old method of separately stating the cost of repairs, again for the purpose of comparison, one year with another. Plant should not include repairs and maintenance of tools, which similarly to supervision is included in general charges and is, therefore, debitable to management account.

5. Salaries of outdoor superintendents and inspectors.

The remarks to item 3 apply also in this instance.

6. Wages at static transformer stations.

Should read wages at transformer and sub-stations.

7. Repairs and maintenance, viz., should read as follows:—(*a*) Transformer and sub-stations; (*b*) Mains; (*c*) Services (why are *house* services only specified?); (*d*) Meters and other apparatus on consumer's premises.

Motors, stoves and fittings, including wiring installations should be debited to a separate account, and the revenue derived from the same credited thereto, the balance to be carried to net revenue account III.

8. Attendance and maintenance of public lamps; and

9. Works executed for customers and goods for sale should be debited to a private works account. The general charges applicable to this class of work should also be debited and credit taken in management account, whilst the balance should be carried to net revenue account No. III. Departmental accounts should be separately stated, so as to show that profits are not being inflated at the expense of the local authority generally.

10. Rents, wayleaves and easements.—The net amount only should be here shown, all rents, &c., receivable being credited in general ledger, and not, as stated in the form of accounts, shown on the credit side of the account.

11. Rates and taxes.

12. Salaries (all salaries should be included).

13. Central establishment charges.

14. General establishment charges.—Under this heading should be included repairs and replacement of tools, sick and holiday pay, &c., and credit taken for establishment charges debitable to capital and private work.

15. Printing and stationery.

16. Advertising.

17. Law charges.

18. Insurances and compensations.

What distinction can there possibly be between (16) "Other establishment charges" and (19) "Miscellaneous"?

19. Allowances to officers and servants.—This item, under the heading of Superannuation, is a welcome indication of a general raising of the municipal service to the level of the Civil Service, and this is, we consider, as it should be.

Cr.

1. Private lighting supplies.—Quantities of current sold, and the various prices obtained, should be shown.

2. Power and heating supplies.—Quantities and prices at flat rates; number of kilowatts at rental rates; and quantity of current at average rate.

3. Bulk supplies.—Quantities, rates and rentals to be inserted.

4. Tramway supplies.—Quantity and rate to be inserted.

5. Public lighting supplies.—Quantity and rate to be inserted.

6. Minimum charges.

7. Meter rents.—Total income in respect of electricity sales.

Discounts and other allowances should be deducted from the above items separately, and not in bulk, as recommended, whilst bad debts should be debited to Net Revenue Account No. III.

By following the above system, it will be possible to ascertain the net average prices obtained under the various headings, and also the net total average price. Under the first three heads, by stating as we suggest, it would be possible to detect preferential rates, which is of great importance.

The suggestions made in regard to Revenue Account II would alter to some extent the form of Net Revenue Account III, otherwise we have little comment to make upon the latter. It is, perhaps, a happy augury that provision for bank interest is made on the credit side of the account only, and if the redemption fund, sinking fund or loan fund, and reserve fund are of adequate proportions, a renewals fund is hardly necessary.

V. Renewals Fund.—This, as stated above, is unnecessary, and, according to existing statute, illegal.

VI. Reserve Fund.—Provision is made on the credit side for "Dividends on Investments." When the extent of the fund reaches the statutory 10 per cent. of capital expenditure, such credits would be illegal. The best course to adopt, in our opinion, would be to credit Net Revenue Account III with all dividends from investments on account of reserve fund.

VII. Capital Account.—Distributing machinery should be separated from generating machinery. Mains should be separate from services (in the metropolitan area mains have been assessed at 30 years' and services at 12 years' life respectively). Meters and indicators should be stated, instead of meters and terminal boxes; the latter, which we take to indicate fuse boxes or cut-outs, being included in "services."

VIII. Balance-sheet.—It is unnecessary to re-state the whole of the capital assets as set out in this form of account, and we think that it is obviously advantageous to divide the balance-sheet into capital and revenue so as to show the balances in favour or against each division.

In conclusion, we trust that our comments upon the whole of the report will receive proper consideration when the recommendations contained therein come up for decision. We have endeavoured to review these recommendations in a manner which we think will be of ultimate benefit to the undertakings controlled by local authorities, and hope that those interested in the management of such undertakings will appreciate our comments from this point of view. A final suggestion to the Local Government Board is that, whilst giving full consideration to expert evidence from the accountancy side of the question, it should endeavour to obtain and consider the views of those interested in the technical and administrative work of municipal electricity supply.

PROCEEDINGS OF INSTITUTIONS.

An Electrically-Controlled Single-Lever Testing Machine.

By Charles E. Larard.

(*Abstract of paper read before the* Institution of Mechanical Engineers *at Aberdeen, July*, 1907.)

Among the recent additions to the equipment in the Mechanical Engineering Department at the Northampton Polytechnic Institute, London, is the latest of Mr. J. Hartley Wicksteed's testing machines, as supplied by Messrs. J. Buckton & Co., of Leeds.

This machine is quite a new departure in many of its arrangements, and has given very satisfactory results in testing.

The remarkable control obtained in this machine for torsion, as well as the more usual tests of tension, compression and bending, is due to the use of two electric motors with wide speed ranges, the high range in the rate of straining by hydraulic pressure, and the fact that the handle and other adjustments are controlled from one position. These and other special features, together with an efficient chronograph for indicating the time intervals during straining and loading, will, the author believes, enable fresh investigations on the strength and properties of material to be carried out. The machine is undoubtedly an advance on anything previously accomplished in connection with testing machines of the same type.

The machine is one of Mr. Wicksteed's vertical single lever machines with a low lever ratio, satisfying in every respect the requirements of the Board of Trade. A maximum stress of 150,000 lb. can be impressed on the specimen for tension, compression and bending, while torsion tests can be made on short specimens up to a moment of 400,000 inch-lb.

The poise-weight, which can be given two values, is under electrical control in either direction, or hand-driven when required. The straining for tension, compression and bending is, as usual with these large machines, effected by hydraulic pressure, while for torsion the twist is put on by means of an electric motor.

The power for straining in tension, compression and bending, is applied through an inverted hydraulic cylinder with an enlarged end on the ram, forming a piston moving in the cylinder under hydraulic pressure. The diameter of the piston is 17 in., and of the ram, 16½ in. There is, therefore, an annulus of a ¾ in. on the under side of the piston. The straining is effected by the water-pressure acting upon the top of the piston; the total resultant pressure on the top of the piston can be increased up to 150,000 lb. The return stroke of the straining ram is effected by the water-pressure in the annular space between the piston and the trunk of the ram, lifting the ram and forcing the water in the top of the cylinder through the exhaust—the exhaust-valve being open.

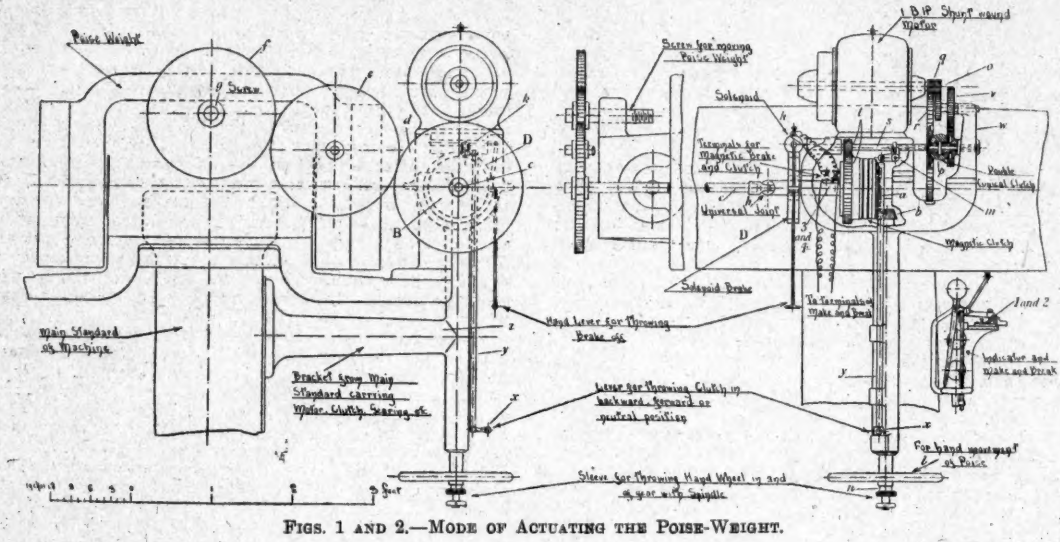
The rate of straining can be controlled over a wide range. The maximum straining rate is about 30 in. per minute with very light specimens, and about 12 in. to 15 in. per minute with the largest specimens when testing to the full capacity of the machine; this is an exceptionally wide range as compared with that usually obtained from many other testing machines.

The method of applying the load is by means of a double-armed steelyard of cast-iron and a travelling poise-weight, which may be given two values, with the addition for heavy testing of suspended weights upon the end of the beam.

The movement of the poise in both directions is effected either by hand or by means of an electric motor, which can be thrown in and out of operation at pleasure. Figs. 1 and 2, p. 452, represent these two methods of actuating the poise. By reference to the illustration, it will be noticed that the handle transmission from the vertical spindle is through a pair of bevel wheels *a* and *b* to the motion shaft *c*, which is geared by three equal spur-wheels, *d*, *e* and *f* to the screw *g* driving the poise-weight. The double Hooke or flexible joint *h* between the horizontal shaft and the first gear wheel *d* carried by the movable beam, is shown on the right-hand view to the left of the solenoid brake *k*, to which reference will be

made presently. The hand-wheel *l* can be put in and out of gear with the vertical spindle by means of a sleeve *n* sliding on the end of the spindle underneath the handle, this arrangement being convenient when it is required to drive the poise-weight by means of the electric motor. The shunt-wound electric motor, which is on the top of the gear-box, carried by a bracket from the main standard of the machine, develops 1 H.P. at 1,200 R.P.M., and has a variable speed down to 600 R.P.M.

The speed variation is obtained by means of a variable adjustment consisting of a twelve-point resistance-frame in the shunt field of the motor. It is thus possible to obtain a speed variation of 2 to 1 and a step-by-step variation of speeds between these limits either on the forward (or loading motion of the poise-weight) or on the return of the poise: but by means of the gear *o* and double conical clutch *p* shown in the right-hand view, fig. 2, a


Poise Weight
Screw
Main Standard of Machine
Bracket from Main Standard carrying Motor, Clutch, Gearing etc.
Hand Lever for Throwing Brake on
Lever for Throwing Clutch in backward, forward or neutral position
Sleeve for Throwing Hand Wheel in and out of gear with Spindle
Screw for moving Poise Weight
Solenoid
Terminals for Magnetic Brake and Clutch
Universal Joint
Solenoid Brake
To Terminals of Make and Break
Indicator and Make and Break
For hand movement of Poise

FIGS. 1 AND 2.—MODE OF ACTUATING THE POISE-WEIGHT.

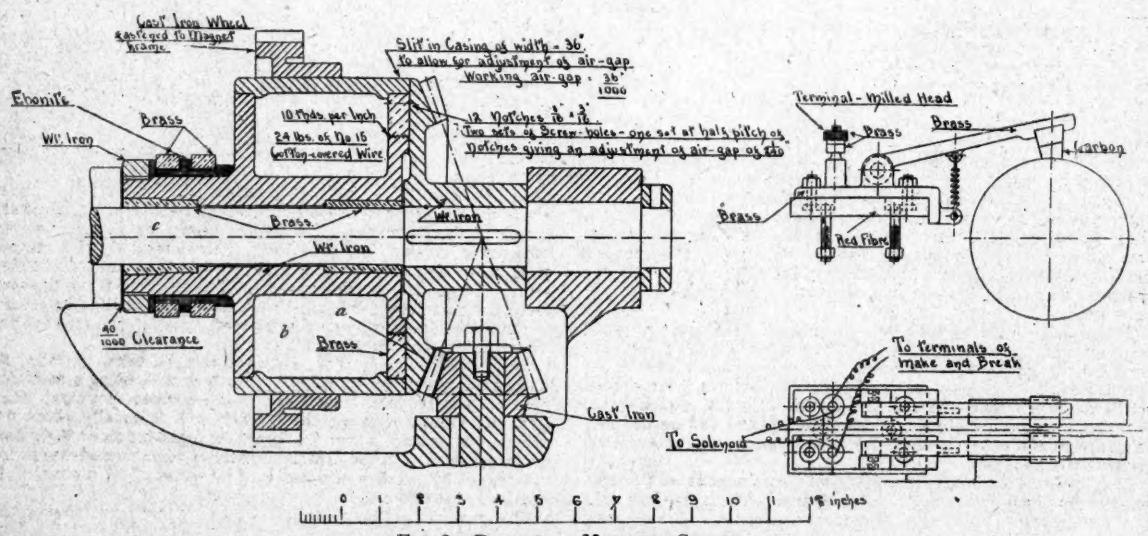

Cast Iron Wheel
Ebonite
Brass
Wr. Iron
10 Rods per Inch
24 lbs. of No 16 Cotton-covered Wire
Slit in Casing of width = 36/1000"
To allow for adjustment of air-gap
Working air-gap = 36/1000"
12 Notches to 1"
Two sets of Screw-holes - one set of half pitch of Notches giving an adjustment of air-gap of 1/24
40/1000 Clearance
Terminal - Milled Head
Carbon
Red Fibre
To Terminals of Make and Break
To Solenoid
Cast Iron
inches

FIG. 3.—DETAILS OF MAGNETIC CLUTCH.

quick return at double the speed of the forward motion can be obtained, so that the two ranges of speed of the poise-weight as between the slowest motion forward and the quickest motion backwards is as 1 to 4.

By referring to fig. 2 it will be seen that a small pinion *q* on the motor spindle gears with a wheel *r* eight times its diameter on an intermediate shaft *s*, and that this motion is transmitted through another train of wheels *t* to the shaft *c* connected to the first gear-wheel *d* on the steelyard. For the reverse motion of the poise the clutch is thrown over to the extreme right, so as to engage with one of two equal toothed wheels on the intermediate shaft *s*, the other wheel *v* being attached to the bracket *w*, carrying a spindle from which a 2 to 1 transmission by the motor is effected. A convenient handle control *x* for throwing the clutch in and out of gear, is supplied just above the ordinary handle control for the poise. A vertical spindle *y* passing up the supporting bracket *z* and connected at its upper end with a bell crank lever *m* and small worm and nut, enables the clutch to be readily connected with either the forward or backward drive. The handle regulator referred to has therefore three distinct positions:—(1) The neutral position, when the clutch is out of gear with both the forward and backward driving-wheels; (2) the position to the extreme right, which brings the clutch into gear with the forward driving-wheels; and (3) the position to the extreme left, which brings the clutch into gear with the backward driving-wheels.

For continuous and steady testing, the movements of the poise should be effected automatically, and in this machine considerable ingenuity has been shown in arranging for an automatic control of the poise-weight. In addition, it is of the highest importance that during the process of testing the poise-weight shall instantly be brought to rest when the positive end of the steelyard approaches the bottom stop; that is, the poise-weight must not overrun its correct position on the scale. Both of these difficulties have been successfully overcome; the first by means of a magnetic clutch and an automatic make-and-break controlled by the rising and falling of the steelyard, and the second by means of a solenoid or magnetic brake.

The details of the magnetic clutch are shown in fig. 3. The clutch is arranged in connection with the larger bevel wheel *a* shown in figs. 2 and 3, fixed on to the horizontal shaft *c* transmitting motion to the poise. When the steelyard is floating, the electrical circuit round the windings *b* of the clutch is closed, making the clutch a powerful electro-magnet firmly gripping the large bevel-wheel *a*, and transmitting motion from the motor, through the gear wheels to the screw actuating the poise; but when the steelyard approaches the bottom stop (as when falling) the clutch circuit is broken by short-circuiting across the terminals 1 and 2, fig. 2, of the make-and-break connected with the beam, the current being then run entirely through the resistance. As soon as the lever again rises or approximates to the horizontal, the clutch circuit is closed and the motor again drives the poise forward or backward as the case may be. It will be observed that by means of the magnetic clutch, the make-and-break and the resistance, the motor is kept constantly running throughout the test, and, indeed, it is important that this should be the case. The solenoid brake D, fig. 2, comes into action when the clutch circuit is broken. Fig. 2 shows the wiring to the solenoid *k* from the terminals 3 and 4 of the clutch circuit. The solenoid brake consists of a pulley B, mounted on the horizontal spindle *c* which transmits the motion to the poise, and round which is fitted a special form of strap D operated by the solenoid *k* at

the top. As soon as the clutch circuit is broken (and with it the solenoid circuit), the soft iron core which is attached to the strap is released, and in the act of release puts the brake on the wheel, thus ensuring that the poise-weight is stopped dead at the instant the beam falls below its proper position. The brake is automatically released on the lifting of the beam and completion of the clutch circuit. The special function of the solenoid brake is to prevent the poise-weight over-running its true position at any stage during the loading or at the sudden fracture of the specimen. While the clutch is in operation the speed of the motor can be varied, as already pointed out, from 1,200 to 600 R.P.M., so that with the wide range of variation in the time-rates of straining and loading, the machine has a greatly increased value as an instrument either for research work or rapid commercial testing.

The author of this paper has been very much impressed with the wonderful control and steadiness given by this machine throughout the plastic stage of tests on ductile materials. The quick return, which can be put into operation almost instantaneously, is especially useful when the maximum load is reached. The higher speeds given by the motor to the poise-weight are much greater than could possibly be obtained by hand in the usual way.

It will be noticed by reference to fig. 2 that the scale and pointer, showing the magnification of the movement at the end of the steelyard, is directly in front of the operator controlling the handle movements, so that it is not necessary to watch the movements at the end of the beam.

Reference has already been made to the importance of arranging, as far as practicable, for the handle and other controls to be worked from one position. In the machine described in this paper no less than a dozen handles, controllers or levers can be operated from one position. This, the author claims, is a very remarkable achievement in itself.

The machine is arranged for testing specimens in torsion up to a twisting moment of 400,000 inch-lb. This is considerably in excess of anything that has previously been done in connection with machines of a similar size. A 3½-in. specimen of mild steel up to 15 in. long can readily be tested to destruction.

The torque on the specimen is given by the product of the scale-reading indicating the position of the poise on the steelyard, into the 4-in. distance between the main knife-edge of the machine and the knife-edge carrying the direct straining mechanism for tension and compression.

The large spur-wheel through which the torque is applied is graduated over the full circle to indicate its angular motion, and this motion can be conveyed through two wheels and a small pulley geared up to the outer socket to the autographic recorder; this recorder is positively geared to the poise on the steelyard, so that both the torque and twist are registered autographically as the test proceeds. Special instruments are provided for attachment to the specimen for the measurement of the elastic strains. The chronograph with the autographic recorder gives the intervals of time, torque and twist rates, at which the angular movement takes place.

An electric motor of 1½ B.H.P. is used for driving the gearing by means of which the twist is applied.

The variable resistance which is applied in connection with the electric motor, together with the change of speed given by means of stepped cones, enables the rate of straining to be altered not only to a nicety on a fine adjustment, but also quickly over a wide variation. The result is that a most efficient control is obtained on the steelyard when a test is in progress. The specimen can be twisted at any rate from one-tenth of a turn per minute to one turn per minute, thus giving a range of 10 to 1 on the time rate of twisting.

Two special features stand out prominently in connection with the torsion apparatus, that is, (1) Tests to destruction can be carried through in *a small fraction* of the time that would be required by the more usual methods. (2) By using the speed regulator for the poise-motor in conjunction with the regulator for the torsion motor, the steelyard can be brought to and maintained in an almost stationary position during the plastic stage of a test on good ductile material.

The torsion gear is also provided with square ends and winch handles for hand adjustment or twisting. These handles are, however, only used in testing the specimen up to and well clear of the elastic limit, the angular movement being comparatively small until the limit of elasticity is reached. The handles are then removed and the straining is effected by means of the power drive.

The Magnetic Character of Vessels.

By CAPT. W. BARTLING, I.N.R.

(Abstract of paper read before the N.E.C. INSTITUTION OF ENGINEERS AND SHIPBUILDERS *on May 24th,* 1907.)

DURING the construction of the steamer *Thueringen* at Bremen, the writer had the opportunity of taking a number of observations with a view to obtaining actual quantitative measurements of the effect of various influences on the standard compass. The results of the experiments show very clearly the typical development of the ship's magnetism.

A bar of iron hanging in the magnetic N. and S. direction, and given the proper inclination for the latitude (say about 68°), will become magnetic after a certain time; reversed it will lose the magnetic power; but if the bar be hammered while in its first position it will retain this magnetic power even if reversed, but will lose the power on being hammered again in the reversed position. Considering a ship as a great magnet, we applied the aforesaid theory to the steamer mentioned, only the magnetic axis was not parallel with the keel.

The *Thueringen* is a cargo steamer 131 metres long, of 16 metres beam, and 10 metres depth. The direction of the building berth whereon she was built is S. 53·3° E. The circumstances were very favourable from the experimental point of view. Owing to a strike of riveters, the whole ship was completely plated and all bulkheads and decks built in, while only about 5 per cent. of the riveting was finished (exclusive of the double bottom). The first experiment was made 10 weeks after the double bottom was built and riveted. The first measurement showed 25 per cent. to be the polaric power of the ship; the direction was nearly opposite to the horizontal-magnetic power of the earth. The vertical power was increased by 33 per cent. of the vertical-magnetic power of the earth. A month later about 40 per cent. of the riveting was completed, and the process of induction had considerably advanced, to about 34 per cent. Again, a fortnight later, 60 per cent. of the riveting being finished, the induction was proportionally increased.

By the time the *Thueringen* was ready for launching the ship was a magnet of considerable power—namely, about 57 per cent. of the horizontal-magnetic power of the earth. The vessel, after launching, was swung and placed as near as local conditions would permit, in the opposite direction—namely, N. 32° W. Before, while on the berth, it was S. 53° E. The success of this measure was perfect, the magnetic power decreasing from day to day, but considerably quicker than it had increased; after 20 days it was only 15 per cent. of the earth power. Compared with this turning of the vessel, the addition of the funnel, masts, engines and boilers had only a very small influence on the ship. The magnetic conditions proved to be very satisfactory for both the compasses on the flying bridge; the *Thueringen* went to sea without a compensating magnet for the standard compass and with only one compensating magnet for the steering compass. The deviation of the standard compass after the trial trip was N. = + 5° (E.), E. = + 7° E.

A second ship, nearly a duplicate of the former, was afterwards built on the same building slip in nearly the same time. The magnetic conditions were found practically similar, the ship's polaric magnetic power being 59 per cent. of the earth's power on the launching day. *This vessel was not swung* and her head lay S. 31·3° E. during completion and outfit. The magnetic power continuously increased after launching, a maximum value of 68 per cent. of the earth's power being reached when the ship was ready for sea. The deviation of the standard compass, without any compensating magnets, was N. = + 22° (E.), E. = + 56° (E.). As a result of the above, seven compensating magnets had to be put in the compass, considerably lessening the most valuable quality of the compass needles, namely, the strength of the horizontal power in pointing to the magnetic north. The conditions on plain cargo boats are very simple, but become more complicated on passenger vessels with many decks and closed steel bridge houses. It may be added that the rails of the flying bridge of the *Thueringen* were of galvanised iron, except two small sections 6 ft. long, one immediately in front and the other immediately abaft of the compass. In the second ship (having the greater deviation) all the rails within a radius of 10 ft. were of brass and teak in order to improve the compass.

All horizontal bars (both longitudinal and athwartship) underneath the compass have a weakening effect on the horizontal polaric power of the instrument. In steam vessels the material near the compass to be taken into consideration consists mostly of horizontal steel bars. It is evident that the power of a compass on a steel ship is always smaller than on shore. The influence is not the same on all compass points, it is mostly stronger on E. and W., on account of the greater proximity of the induced poles in the athwartships direction, than on the N. and S. course.

If the horizontal power on shore = H be taken as unity, the horizontal power on board will be = $\lambda \times H$, λ being a coefficient varying with the local conditions of the compass position. On a normal merchant steamer the coefficient λ is usually about 0·8; that is, the polaric power on board is eight-tenths of the polaric power on shore. In the conning towers of some men-of-war it does not exceed 0·3; such a compass is of no use at all. In general, the greater λ, the better the compass position.

The simplest and best solution of the compass question would be to use unmagnetic material for the ship; cost price, about £100 per ton. We have used unmagnetic nickel steel in our newer ships in the near vicinity of the standard compass with good results, the alloy containing 23 per cent. of nickel.

In one of our large vessels now building, we have interrupted all the horizontal steel in the deck under and above the compass and replaced it with 6 ft. of nickel-steel bars containing 23 per cent. of nickel. From the experiments on this ship the writer hopes to arrive at a λ of from 0·9 to 0·95, an improvement of probably about 15 per cent.

In the discussion, Mr. J. W. GILLIE said that the Liverpool Underwriters' Association in 1870 suggested that a ship, when launched, should be fitted out with her head in the opposite direction to that in which she had been built. It was better, when arranging a position for a standard compass, to aim at preventing the deviation changing, rather than at merely increasing the directive force. The art of compass adjustment, largely through Lord Kelvin's practical application of scientific principles, had advanced very greatly during the last few years, and very few ships left the Tyne with a directive force in the position of the standard compass much under ·9. Several times after adjusting the compasses of the s.y. *Midnight Sun* previous to sailing on the first trip of the season, they found the deviation changed and allowance had to be made. It occurred to him that if after putting her in the dry dock, she was moored head down the river the last few days

before sailing, instead of head up, they would overcome the trouble. This was done, and for several years there had been no change such as was experienced at first.

Col. R. Saxton White said he had always understood that steel or iron in a horizontal position had not nearly so much effect on the compass as when in the vertical position, and therefore if they could do away with the vertical pillars or stanchions in the neighbourhood of the standard compass, horizontal steel or iron did not matter very much.

Other members also spoke, and in his reply to the discussion, Captain Bartling said that the magnetism which appeared, if the ship was steering the same direction for a long time and suddenly changed the course considerably, was induced magnetism, and the ship would always lose it again after a few hours on the new course. This induced magnetism would always appear, and ship captains must give it very careful consideration.

EXPERIMENTS ON SOLDERING.*

A Contribution to the Testing of Materials, by Adolf Lippmann, Cologne.

In due appreciation of the importance of good and durable joints in heavy-current electrical work, the present Rules of the Verband Deutscher Elektrotechniker contain a definition the phrasing of which is open to contention. It runs:—

Sec. 26 (*e*).—"For the purpose of soldering, no soldering materials may be employed which attack the metal."

Weber's explanation is:—"Resin can be suitably used as a soldering material, but on no account may acids be used." (Erläuterungen zu den Sicherheitsvorschriften des Verbandes Deutscher Elektrotechniker," 1906, p. 111, footnote 8.)

Although this only states that acids should not be used in soldering, one can, perhaps, detect in it the reason for the quite recent introduction for electrical purposes of a number of soft solders, whose "complete or total freedom from acid," as complying with the rules of the Society, is put forward as a special advantage.

The endeavour to simplify the process of soldering and effect economy in material is, without doubt, justified, in view of the by no means inconsiderable items of expenditure for soldering material to be met with in the erection account of the contractor. There appears, however, to be no justification for the endeavour to infer from the quoted explanation that a flux must be completely free from acid in order to conform to the Society's Rules. Apart from the fact that the proper action of soldering is, perhaps, dependent on the influence of the acid, such an interpretation also leads to inconsistencies, for it will be shown later that a solder which gives a distinct acid reaction with litmus nevertheless contains far less acid than resin. In arriving, therefore, at the just estimation of the acidity of a flux, it should not be overlooked that resinous bodies themselves are by no means free from acid.

In the following will be found some investigations on the degree of acidity of fluxes and the resulting effect on metals. It will then be shown in addition to the experiments on solders published by Dr. M. Corsepius† how far mechanical experiments (tensile tests) and electrical experiments (resistance measurements and load tests) are suitable for deciding the quality of solders. And, finally, from the described experimental results deductions will be developed which can become matters for consideration in testing soldering materials.

To form a true estimate of the part played by the acid, it is necessary, in the first place, to investigate the process of soldering itself. Soldering is the art of firmly uniting two pieces of metal, by applying a metal or metallic mixture—the solder—of a lower melting-point than the metals to be joined, in the molten state. The union is the more intimate the closer the relationship of the soldering metal to the metals to be united, a fact which is decisive in the selection of the solder.

To make a good soldered joint it is essential that the soldering material be made sufficiently fusible, and that the surfaces to be soldered be thoroughly clean and metallic, and during the soldering process be protected against oxidation. Metallic and clean surfaces can be produced by mechanical means (filing, surfacing, scraping), or by chemical means (dipping, etching).

According to Schlosser‡ soldering materials can, in general, be divided into four groups according to their activity:—

Group I.—Soldering Materials which Exclude Air.

Here the substance used with the solder is solely for the purpose of preventing the access of air to the metal surfaces which have been previously polished by filing and surfacing, *i.e.*, of preventing oxidation. Strictly speaking, clay is the only substance which can be mentioned as capable of entirely excluding air, but its application is only considered in rare instances and for coarse soldering. It is true that borax also possesses the peculiarity of forming when molten a vitreous layer which shuts out the air; as, however, this soldering substance, in addition, acts as an oxide solvent, it is placed in Group II.

Group II.—Soldering Materials which Act as Solvents.

The substances belonging to this group all have the property in common of dissolving the compounds which would retard the union of the two metals. These compounds may be oxides (rust), salts (the green film on copper) or sulphur compounds (the black film on copper). Accordingly, in this group are used:—Borax, or acid sodium borate; if this be heated with a metallic oxide, the excess of boric acid present dissolves the oxide and forms with it a salt which, reacting with the simple sodium borate, gives rise to a double salt. If, for example, borax be used in soldering copper, the resulting copper borate dissolves in the excess of borax, colours this green and forms a double salt (copper sodium borate).

Glass powder, as well as the frothy mass known under the name of glass-gall, the scum which in glass manufacture rises on the top of the molten glass, and also sharp sand and water-glass, belong to the solvents used in soldering; their action is due to the presence of silicic acid.

Finally to this group belong:—Phosphoric acid, as well as the acid salts of phosphorus (acid sodium phosphate and acid ammonium phosphate); and cryolite, a compound of sodium fluoride with aluminium fluoride. Here the solution of the oxides takes place with the simultaneous formation of metal fluorides.

Group III.—Corrosive Soldering Materials.

By the use of soldering materials which eat into the metal, the previous filing or scraping of the metal surfaces to be joined can be completely dispensed with, as they not only at once dissolve any layers of rust adhering to the metals, but by attacking the metal itself produce in the most reliable manner clean, metallic contact surfaces.

Schlosser says here:—"On account of these properties the use of corrosive soldering materials is a matter of great convenience, and they are employed in considerable quantities by those metal-workers who are constantly engaged on soldering work. The majority of the so-called soldering fluids belong to this category of soldering materials."

To this group belong:—Hydrochloric acid, zinc chloride and ammonium zinc chloride.

Group IV.—Reducing Soldering Materials.

In consequence of their greater affinity for oxygen, these soldering materials remove the oxygen from the metal oxides, *i.e.*, they reduce them to the purely metallic state.

In this group are:—The resinous bodies, especially resin, stearin, turpentine resin, potassium cyanide, and, finally, sal-ammoniac.

Knowing from experience that certain of the soldering substances enumerated—for example, zinc chloride—increase the fluidity of the solder, so that it penetrates the finest recesses, preparations may be made from suitable combinations of individual materials, which, without doubt, considerably facilitate the work of soldering, although it is not possible absolutely to dispense with the skill of the workman.

We now turn to the review of the much-disputed question of the acids. Whether the limits between the groups are to be so sharply defined, whether, for example, with the one or other soldering substance, the active acid besides dissolving the oxide also effects the corrosion of the metal, *i.e.*, attacks the metal, are matters that may remain undecided. At any rate, by reason of what has been set forth in Group III, one can maintain that the corrosive action of an acid is beneficial rather than injurious in making a good soldered joint, as indeed this corrosive action produces in the most reliable manner possible the requisite clean, metallic contact surfaces. The question also seems here well worthy of consideration, whether a clean metal surface cannot be obtained with a considerably smaller waste of the metal by means of corrosion with an acid than by mechanical aids (filing, scraping, or surfacing).

The objections which one may have against the "acidity" of a soldering substance should, therefore, not extend to the action of the acid during the soldering process itself—as here it can only act beneficially—but to possible after-effects, corrosion, &c., which may occur especially through neglect on the part of the workman. With the subsequent thorough cleaning of the joint (by rinsing or boiling) hardly an objection can be raised even against the direct use of an acid in soldering. Such considerations can only affect the doubtful reliability of the workman, with which one has to reckon. But even here under certain circumstances one has to ask oneself the question, which can produce the greater harm, a bad mechanical joint, or possible corrosion in consequence of negligent workmanship?

A practical example may serve here to elucidate the trend of thought. Shortly before the opening of the Jungfrau Railway a turn-out had to be soldered to the overhead wire. The soldering was carried out with resin in accordance with the instructions issued. After the passage of two trains, however, the joint came undone, and the overhead wire fell to the ground. As the work was most urgent, in view of the impending opening of the line to general traffic, the superintending engineer gave instructions for the joint to be soldered with hydrochloric acid; he evidently was well aware that in this manner he would obtain a reliable connection. No further attention was paid to the joint until, at the end of the season, the overhead wire was taken down for the coming winter. It was then seen that the use of the pure acid had produced no further damage than a slight incrustation on the copper in the neighbourhood of the joint; the soldering had held perfectly.

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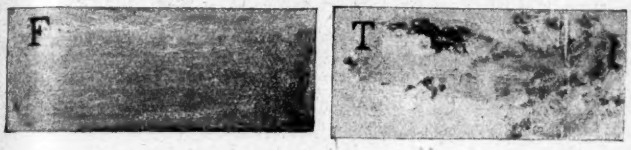
* From the *Elektrotechnische Zeitschrift*. Published by Julius Springer, Berlin.

† "Verhandlungen des Vereins zur Beförderung des Gewerbefleisses." 1906, and "Z.d.V.D.I." 1907. No. 23, p. 906.

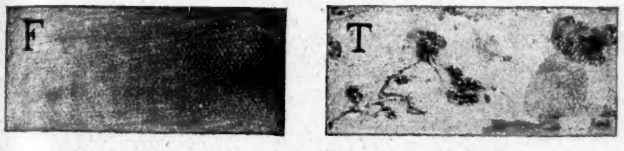
‡ E. Schlosser, "Das Löten," Wien, 1905. Hartleben.

With cross-sections such as occur in the overhead wires of a railway, it is, without doubt, of small moment whether the material used in soldering attacks the metal a little more than is absolutely necessary for the production of clean metal contact surfaces; here, at any rate, the disadvantage of a larger waste of the metal counts but little in comparison with the advantage of a reliable joint, which can certainly be attained by the use of corrosive soldering substances, even in the case of strongly oxidised, dirty surfaces, without previous cleaning. Quite different, however, are the conditions in making soldered joints, where reductions of cross-section are to be scrupulously avoided—for example, in soldering resistance wires for use as series resistances with measuring instruments, &c.

Taking, however, the fact here into consideration, that for obvious reasons soldering of this description, as a rule, would be entrusted only to experienced and reliable workmen, the danger of possible after-effects of the acid is reduced to modest dimensions.



Hot Test.

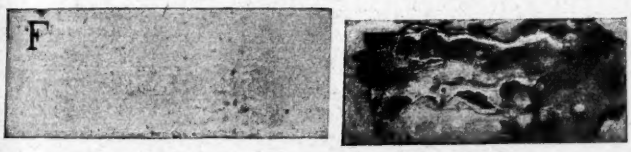


Cold Test.

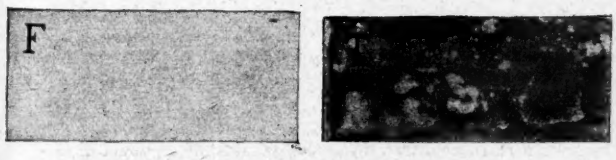
Fig. 1.—Tests with Soldering Materials: Before Rubbing Down.

Moreover, one cannot well deny that in fine work an unskilful jointer can by overheating under certain circumstances do more damage than by the negligent use of acids.

In view of the reasons mentioned above, at the February meeting of the Kölner Bezirks-Verein Deutscher Ingenieure, I strongly protested against the far too heavy emphasis of the "freedom from acid" in solders; first, because I had come to the conclusion that one cannot dispense with the action of an acid if one wishes to abandon the thorough cleaning—whether by mechanical or chemical means—of the metal surfaces to be joined, before the soldering process is commenced; secondly, because I found



Hot Test.



Cold Test.

Fig. 2.—Tests with Soldering Materials: After Rubbing Down.

from my investigations that so-called totally acid-free soldering substances may certainly as delivered not contain acids, but can still give rise to their formation. For the same reasons I have criticised the far too ambiguous wording of Sec. 26 (*e*) of the rules of the Verband Deutscher Elektrotechniker with reference to the attacking of the metal, as I do not believe that it is possible to produce the clean metal surfaces necessary for a good soldered connection, by the complete avoidance of waste—however trifling—of the metal.

In confirmation of my views, I submitted to the meeting samples of copper which had been treated with two different fluxes—a so-called totally acid-free flux (Tinol) and another one (Fludor), which makes no claim to freedom from acid. The plates of electrolytic copper were first carefully faced and cleaned with chalk, and, after being smeared with the two fluxes, were heated together on asbestos to the melting temperature of the normal soft solder, and then left to cool (hot test). Two plates prepared in the same way were kept cold for a week under cover (cold test). The plate which had been smeared with the Tinol flux, soon after cooling, became coated with thick layers of an intense green coloration which appeared to point to chlorine compounds of copper. The cooled Fludor plate showed a brownish layer of cuprous oxide, which only after eight days assumed in isolated places a faint, dirty green coloration (probably due to the action of the carbonic acid of the air, a light incrustation of copper carbonate was formed.)

The plates which had been smeared and left standing in the cold condition, on February 11th—*i.e.*, after 24 hours—showed a very different appearance. Whereas the Tinol plate had already begun to put on strongly coloured greenish layers, the Fludor plate remained unchanged. On February 19th the plates were photographed, and their appearance is shown in fig. 1. On February 22nd the plates were rubbed down with clean wool (see fig. 2).

Confirmatory tests carried out in the same way with polished copper plates presented for Tinol a different appearance according as the sample was taken from fresh tins or from tins which had been in use for some time. As Tinol consists in the main of glycerine and a solution of sal-ammoniac and the metal solder mechanically mixed in a finely-divided state, the possibility of the formation of free hydrochloric acid seemed feasible to the author. Ammonium chloride solutions are well known to have the peculiarity that the ammonium chloride undergoes a dissociation, whereby ammonia is liberated, and some free hydrochloric acid remains in the solution ($NH_4Cl = NH_3 + HCl$ + Water). The complete separation of the pure ammonium chloride into ammonia and hydrochloric acid gas takes place at 350° C. If ammonium chloride be heated, it sublimes without melting, whereby the above dissociation occurs; after cooling it recombines to sal-ammoniac.

If, however, ammonium chloride be in *solution*, the separation appears to take place at considerably lower temperatures; also it seems that the recombination of the hydrochloric acid gas with the ammonia is in this case not so rapid. The experience that fluxes which contain an excess of sal-ammoniac in solution, in the course of time, always become more acid might be explained in this way; at any rate the amount of hydrochloric acid might be all the more increased, the less one prevents a liberation of the evolved ammonia by means of tightly-closed vessels. The probability of the formation of hydrochloric acid led to the following additional experiment:—Carbonic oxide gas was passed over the Tinol flux melted on the copper plate. Tiny crystalline, needle-shaped leaves separated out, which point to the presence of cuprous chloride (CuCl or Cu_2Cl_2). Cuprous chloride readily dissolves in concentrated hydrochloric acid; the solution has the characteristic property of absorbing carbonic oxide gas; from the hydrochloric acid solution saturated with gas colourless leaflets separated out having the composition $Cu_2Cl_2 + CO + 2H_2O$ (cp. Richter's "Lehrbuch der anorganischen Chemie," edited by Dr. H. Klinger, p. 379. Bonn, 1893).

The author believes he can see here the proof, that even with this acid-free material an attack of the metal is possible. It certainly could not appear possible in the case of the Tinol paste to separate the flux from the metal mechanically mixed with it, and test it by itself, especially as the whole mass should be well stirred before use. As, however, the soldering metal is only *mechanically* mixed with the flux in the form of fine powder, it does not appear quite clear why the flux should acquire other properties from the intermixed metal. Quite apart from this, however, there is in the objection mentioned a misconception of the actual object of the described experiments. By conscientious testing of such soldering substances, one feels oneself all the more driven to such tests, the more emphatically the manufacturers proclaim their material to be independent of the reliability of the workman.

It is a matter of considerable interest to see what will happen if the regulations are disregarded. Suppose that the soldering paste is somewhat too lavishly applied, and that the workman omits through negligence to wipe off the remainder of the flux. Then just that might occasionally happen which the copper samples have shown. Of two soldering materials, equal in value as regards their utility, that one will undoubtedly merit the preference which, with possible negligent handling, produces the lesser amount of harm.

In further elucidation of the acid question, at the request of the author, samples of the three most widely used soldering substances were submitted for test to the Department for Testing Oils of the Kgl. Material-Prüfungsamt at Gross-Lichterfelde. The test certificate A, No. 37,492, department 6, No. 4,250/1-3 of April 18th, 1907, gives the following abstracted results:—

First of all (A.) American resin, (B.) Tinol, (C.) Fludor soldering paste were tested for acidity.

The request was made that the three samples should first be examined for acidity in their delivered condition. In consideration of the possibility of a formation of hydrochloric acid at the higher temperatures, it was further requested that samples B. and C. should be kept for one hour at 100° C., and after cooling be tested again.

The amount of free organic acid is reckoned as the acid-figure (on the acid-figure cp. Dr. D. Holde, "Untersuchung der Mineralöle und Fette," Berlin, 1905, p. 155). The amount of mineral acids is reckoned as a percentage of hydrochloric acid (S = organic acids; M = mineral acids). Tests on delivery:—

A. Resin	... ...	S = 167·5	M absent
B. Tinol	... ...	S = 0·38	M „
C. Fludor	... ...	S = 23·7	M „

Test after heating to 100° C.:—

B. Tinol ... S = 0·03 M = 0·15 per cent. hydrochloric acid.
C. Fludor ... S = 23·7 M absent.

Quite apart from the fact that hereby the assertion made above in connection with the behaviour of ammonium chloride solutions is substantiated, the test shows a very remarkable result. It teaches above all that the exaggerated and unjustifiable estimate of the value of the absolute freedom from acid might occasionally lead to the rejection of a material, the use of which is at least as free from objection as resin, chiefly, no doubt, because until now no one had thought of proving that even resin contains quite a considerable amount of free organic acid.

In testing soldering materials one must, therefore, not content oneself with indicator tests (litmus or phenolphtalein) for determining acid reactions. Only true comparisons can be made from the determination of the amount of acid and, above all, the kind of acid. As the organic acids with few exceptions are considerably weaker than the weakest inorganic (mineral) acids, fluxes with only an organic acid content will always be preferred, as soon as one knows that possible bad after-effects arising from negligent handling will most probably be precluded. The only question that arises here is whether organic acids suffice, *i.e.*, whether such soldering materials give a satisfactory action. Exhaustive tests with the above-mentioned Fludor preparation, which, according to the official experiments, shows an amount of 23·7 (reckoned as acid-figure) of organic acid, have nevertheless given very satisfactory results, not only as regards its goodness as a flux, but also with reference to its reliable soldering action. The weak organic acid only does its work where it should—*i.e.*, in the heat of the soldering process; bad after-effects, such as can only occur in consequence of negligent handling (insufficient cleaning of the soldered parts, excessive application of the flux, &c.) are here not at all to be feared. As the organic acids when cold do not attack the metals, Künkler believes that in testing lubricants for cold-running machine parts the presence of organic acid is without hesitation admissible. (A. Künkler, "Die Maschinenschmierung, &c." Mannheim, 1893.)

In view of the above explanations, one may arrive at the result that in testing soldering materials, which in a practical test for reliability of effect, ease of handling, &c., are proved equal in value, that one is to be preferred which only contains organic but no mineral acid.

(*To be continued.*)

MANCHESTER AND SALFORD ELECTRICAL EXHIBITION, 1908.

The following is a copy of a circular letter which was addressed to electricity works engineers on September 14th, signed by Mr. W. Davenport, secretary of the National Electrical Manufacturers' Association (Inc.):—

"As you have doubtless noted from articles recently appearing in the Electrical Press, the above Corporations have decided to promote, in conjunction with this Association, an Electrical Exhibition in Manchester. As the benefits of this Exhibition will have a very far-reaching effect in such a largely populated and important manufacturing area, and will undoubtedly tend greatly to increase the present use of electricity for lighting, power, and other purposes, it is hoped that your Corporation will see their way to give active and financial support to the scheme. It is intended to ask for this in the form of donations, in exchange for which tickets of admission to the Exhibition, printed specially for each authority, will be supplied to the various contributors for free circulation in their respective areas at the rate of 3s. per dozen, proportionate to the amount voted.

"So soon as the list of contributors is complete, a meeting will be arranged to elect representatives to serve on the Advisory Committee. The profits arising from the Exhibition will be allocated in a percentage, to a return to exhibitors, to a return to contributors, to the charities connected with the electrical industry, and to a charitable institution nominated by the Manchester and Salford Corporations, and situated in their respective districts.

"For your information, I might say, that the general scheme of carrying on the Exhibition, will be based on the lines adopted so successfully by the supply companies and municipals in London in conjunction with this Association, at Olympia in 1905. The Lord Mayor of Manchester, supported by the Mayor of Salford, has kindly consented to convene a meeting of chairmen and engineers of corporations, urban councils and supply companies in the district, to be held on Tuesday, September 24th, the invitation to which you will receive in due course.

"In the meantime I would ask you to be good enough to bring this letter before your Committee, in order that they may become interested in the matter at an early date."

Cheap Metallic Filament Lamps.—It is announced that the Continental glow lamp syndicate (Verkaufstelle der Vereinigten Glühlampen Fabriken) of Berlin has decided to introduce a metallic filament lamp which will economise the consumption of current. The economy in the use of energy as compared with carbon-filament lamps will be 30 per cent. and the useful life will be about 500 hours. It is stated that the new lamps will only be a few pfennigs dearer than the price of normal lamps—a statement which may be said to represent 1d. extra.

Price Alterations in Germany.—The Siemens-Schuckert Works Co. have reduced the prices of insulated conductors for heavy currents and insulated copper conductors. On the other hand, the prices for bronze conductors and for insulated copper binding wire have been raised by 9d. per kilogramme.

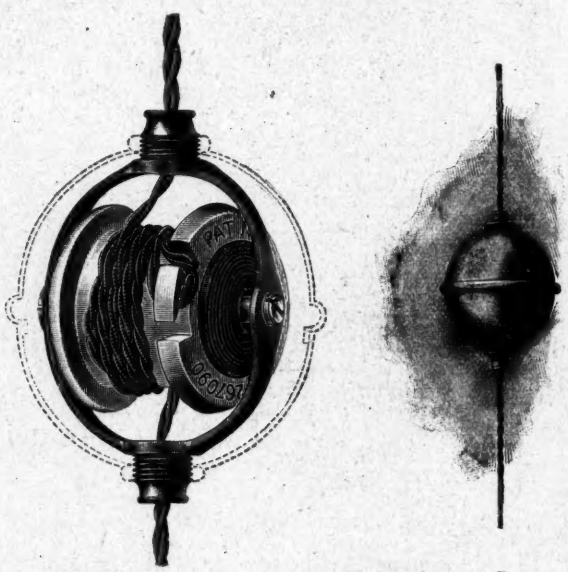
NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

A Modern Adjustable Pendant.

We have received from Messrs. Charles Joyner & Co., Ltd., of Icknield Square, Birmingham, an interesting device in the shape of a patent cord absorber, which in many ways outrivals the ordinary adjustable pendant fitted with a counter weight.

Practically every one using the latter is acquainted with its little ways, and it is not, to say the least, particularly ornamental. Further, its weight undoubtedly throws an undue strain on the ceiling fixture.

The new cord absorber, however, possesses none of these defects, nor does it substitute others, so far as we can see. Consisting, as it does, of a porcelain reel with a clock spring inside, which latter is suitably adjusted to wind up the flex with its attached lamp fittings, there is hardly anything to get out of order. The flex passes in or



Joyner's Patent Cord Absorber, with and without Cover.

out of the absorber through suitable leading-in bushes, as shown in our view, and the device is provided with a globular cover in two parts, fashioned to suit the taste.

Absorbers are now made to suit fittings in all the well-known styles. The reel and frame only can be supplied to makers who wish to use the device with their own adjustable designs. Several different sizes are made in order to support fittings of less than a pound up to 10 lb. in weight.

Messrs. Joyner's latest catalogue, which contains particulars of the above, will also be welcomed by those on the look out for a wide selection of electroliers, standards, and other fittings adapted for the electric light.

Torsion Indicator for Marine Steam Turbines.

The aim of this invention (by Messrs. Bevis and Gardner, of Knott End, Fleetwood), is to show the amount of shaft torque by the movement of an index over a dial, the indication being automatically and continuously given, without the need of preliminary adjustments. The method employed is the variation of current flowing through an ammeter, calibrated in degrees of torsion, the variation being obtained by the relative displacement, due to torsion, of two current-interrupting rings placed widely apart, and rotating with the shaft. The greater the torque, the higher is the reading on the ammeter. Fig. 1 is a diagram of the system. Fig. 2 shows an interrupting ring, of commutator form, mounted on a shaft coupling, the contacts being spaced to provide for a maximum torque of 3°.

The two interrupters B_1 and B_2 are in effect toothed wheels, the spaces being filled with insulating material. They are in electrical connection with the shaft, into which current is led by a brush from a single cell, discharging, when the ammeter gives the maximum reading at, say, half an ampere. A suitable cell is the Edison-Lalande, which maintains a constant E.M.F. of about 0·75 volt for a considerable period when discharging well within its capacity.

The other two brushes shown in fig. 1 are in parallel, so that current can pass from the shaft by way of either interrupter. The rings are secured, or their brushes are adjusted, in such a manner that, with no torsion, contact is made and broken by both rings at the same moment. Figs. 3, 4 and 5 illustrate, in the third column, the current variation resulting from the displacement of the forward and after rings due to torsion. In fig. 3, with no torsion, the two interrupters make and break contact together, and the current effect is as if there is but one ring.

In fig. 4 (half full torsion) the forward ring is advanced,

increasing the time of make and reducing the duration of the break.

Fig. 5 illustrates the effect with maximum torsion, the current being continuous, and always passing through one or other interrupter.

In the calibration of the ammeter, the zero is fixed at half the maximum current. The index is damped to prevent its return at the moment of interrupting the circuit.

Several such indicators may be placed in the circuit, as on the bridge, in the chart room, &c., besides the engine room, and a recording ammeter may be employed to give a continuous record throughout the voyage.

The accuracy of the indication should not be materially affected by wear of the peripheries of the rings, because while the sides of

FIG 1.

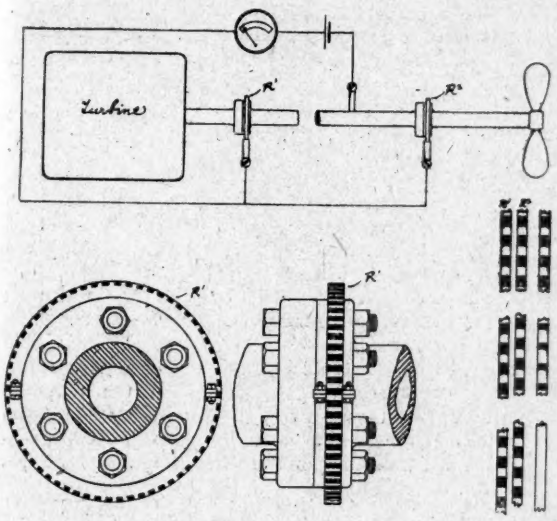


FIG. 2.

FIGS. 3, 4 and 5.

the segments are actually radial, they are virtually parallel. The low voltage and trifling current required, avoid objectionable sparking at the brushes.

We may suggest, as a modification of this device, the arrangement of the interrupters in series through the shaft, the brush on R^2 being connected with the negative pole of the battery, and the brush on the shaft removed. The interrupters would be relatively displaced by the space of one tooth. The calibration would then start from zero current with zero torque, the average current increasing to the maximum with maximum torque. This would reduce the demand on the battery, and any suitable ammeter could be used, the calibration being effected by simply observing the maximum current flowing when the circuit was continuously closed, when other readings would be in proportion.

CONCERNING INSULATING VARNISHES.

BY A. R. WARNES.

Too little consideration is given to the question of the constitution and properties of the insulating varnishes or impregnating materials used to reinforce the cotton and other insulating materials employed in the manufacture of electrical machinery. The chemist with a knowledge of electrical machinery has not been consulted sufficiently. Had he been, the quality of the insulating varnishes now on the market, taken as a whole, would be of a higher standard. They would not contain, as almost all of them do, ingredients which are harmful to the copper vitals of electrical machinery, or which aid in a rapid disintegration of the varnish itself, and, therefore, the insulation which it is intended to reinforce. No chemist would think of advising an engineer to use a varnish which would act upon the copper conductors of the machine, or which dries and hardens by virtue of chemical changes, sometimes assisted by the oxygen of the atmosphere. These chemical changes progress slowly, and as the machines are invariably tested shortly after being varnished, the end of the chemical reaction has not been reached, and, therefore, the test obtained is a misleading one. The result of these chemical changes is, practically without exception, a lowering of the disruptive strength and ohmic insulation resistance, or disintegration due to brittleness. The latter fault is the most frequent in occurrence.

Because a varnish dries quickly, has a fine gloss, gives a high initial disruptive strength and is cheap, it is not a sufficient reason why it should be used. In the long run the cheapest varnish generally turns out the dearest, as the machines on which it is used invariably suffer.

With a view to finding a thoroughly reliable insulating varnish the writer has carried out a considerable amount of chemico-electrical work on these materials, and he has no doubt that some of the results obtained will interest the readers of this journal.

One of the principal ingredients used in the manufacture of insulating varnishes is linseed oil; indeed, some varnishes contain very little else. Now for this purpose linseed oil is one of the worst materials to use. It holds its position in the paint and varnish trade on account of its property of rapidly absorbing oxygen, especially after it has been boiled, and changing into a tough, somewhat elastic body known as lynoxyn. The absorption of oxygen (oxidation) does not stop here, but will continue until a viscid substance, soluble in water to a considerable extent, is formed. However, under the conditions obtaining in electrical machines, the oxidation does not get quite so far as this; the oil film becoming broken and cracked in places long before the final stage of the process is reached. Now, if machines on which varnishes containing linseed oil have been used do not break down from other causes, they certainly will when the condition just mentioned is reached.

The oxidation of the linseed oil in thin films of varnish progresses very rapidly at first, with the result that the films becomes hard and tough. When this condition is reached the oxidation is very slow, but very sure. Many varnishes loose all their mechanical strength and become brittle or powdery long before the oxidation of the film is complete. Other varnishes composed almost entirely of linseed oil, take a much longer time to become brittle, but as they age the detrimental property of absorbing moisture increases. The table below shows the amount of moisture absorbed by three varnishes, one of which was composed almost entirely of linseed oil (*a*), one containing about 15 per cent. of this body (*b*), and one containing no linseed oil (*c*).

	1 day. Per cent.	4 days. Per cent.	7 days. Per cent.	15 days. Per cent.	1 month. Per cent.	5 weeks. Per cent.
(*a*)	·228	·38	·45	·53	·98	1·34
(*b*)	·15	·21	·23	·28	·36	·49
(*c*)	·05	·05	·10	·20	·25	·35

The experiment was carried out under the following conditions.

Pieces of tin plate were cleaned and accurately weighed on a chemical balance. They were then covered with two coats of the respective varnishes, and in order to thoroughly oxidise the varnishes containing linseed oil, allowed to air dry for one week. Then they were baked for 10 hours at 100° F. and six hours at 212° F. to harden the films. They were then removed from the oven direct to a dessicator to cool, and when cold again weighed. By deducting the first weight from the second the actual weight of varnish was obtained. Immediately after weighing, the varnished tin plates were exposed to the atmosphere and weighed at the intervals shown in the table, and the actual percentage of moisture absorbed by the varnish calculated.

In order to be quite sure that the increase in weight was due to absorbed moisture, after the five weeks' exposure, the varnished tins were stoved at a temperature of 70°—80° F. for a few hours, cooled in a dessicator and weighed, when it was found that they had regained their original weights.

To find the amount of moisture absorption when totally immersed in water, tin plates were prepared in a similar manner to that just described, and with the same varnishes. They were immersed in water at a temperature of 60° F. for 24 hours, with the following results :—

Varnish free from linseed oil	0·15 %	absorption.
Varnish containing about 15 % linseed oil ...	0·85 %	"
Varnish composed almost entirely of linseed oil	2·84 %	"

The absorption of moisture by linseed oil varnishes has a serious effect on the dielectric strength of the insulation. The following tests show this excellently :—

F

Pieces of linen were thoroughly dried and then dipped twice into the varnish. One varnish contained no linseed oil and the other was composed almost entirely of this body. In order to allow a thorough oxidation of the varnish containing linseed oil, the pieces of varnished linen were exposed to the atmosphere for two months. They were then stoved at 100° F. for 32 hours, after which they were hung up in a room at a temperature of 60-65° F. for one month, to allow the varnishes to absorb moisture, and then tested (column 1). After this test the same pieces of linen were placed in a stove at 100° F., and kept there for seven weeks. On the expiration of this time they were removed from the oven and, in order to prevent moisture absorption, tested as soon as cold. (Column 2.) To see the effect of further exposure to the atmosphere at a temperature of 60° to 65° F. (moisture absorption) the same pieces of linen were hung up in a room for two weeks, and then tested. (Column 3.)

	1.	2.	3.
	Volts A.C. per mil.		
Linseed oil varnish (punctured) at	462	605	484
Varnish free from linseed oil (not punctured) at	933	933	933

The terminal disks had an area of 2 sq. in., and the top terminal weighed 6 oz. Alternating current was used; periodicity, 42. Temperature during testing, 60° F.

It is only too well known that low ohmic insulation resistance is conjoint with damp insulation. Now, this very undesirable state is aggravated by the use of varnishes containing linseed oil. That an insulating varnish should not absorb moisture, or, at least, only a minute quantity, is a very important point, but it is not very often realised in a varnish. It is well known after a works has been closed for holidays there is a tendency for electrical machinery to break down, and in shipyards and other places, where motors are exposed to humid atmospheres, it is found advisable to leave the field coils excited when the machines are not in use to prevent the chances of breakdown. The reason for this is, that low ohmic insulation resistance is produced by the large absorption of moisture, due mainly to the insulating varnish used on the conductors.

It must also be very clear to the observant engineer that the continual absorbing and drying out of moisture must materially assist in the oxidation and disintegration of the varnish and the impregnated insulation. The insulation is generally cotton or paper, and both these materials are composed of members of the cellulose group of carbohydrates; cotton being almost pure cellulose, and paper a mixture of celluloses and lignocelluloses. Now, water is feebly dissociated into the cation $H^{\cdot}$ (hydrogen), and the anion OH' (hydroxyl), and it has recently been found that cellulose in contact with these ions is continuously modified, both in structure and in chemical function. This modification is a function of the intensity of the reaction and its duration.

Further, cotton contains a certain quantity of acid bodies, derived from pectin, which are soluble in water. We have also the substances dissolved in the water, which is absorbed by the varnish from the atmosphere. Although water is only feebly ionised, it has a remarkably high power of splitting up the molecules of other substances into ions. In doing this it increases the chemical activity and electrical conductivity, and the result is electrolysis and chemical action. The increased number of ions and the nascent oxygen set free during electrolysis will act detrimentally not only on the insulation, but also on the varnish, especially on those varnishes containing large quantities of linseed oil. As already stated, increased oxidation of linseed oil means its greater solubility in water. This means that the capacity for absorbing water is increased, and thus the undesirable actions mentioned above are materially assisted. From these facts it is quite reasonable to consider the absorption of water by the insulation and varnishes as one of the causes of their disintegration and all its attendant evils.

We read in a modern text-book that "The linseed oil compounds are waterproof in the sense that they will not allow water to pass through where there is an unbroken film." Now, this is not correct: if it were, how is it that linen coated with linseed oil varnish, which is allowed to dry and oxidise, and is then stoved, absorbs more moisture from the atmosphere than films of the same linseed oil varnish prepared on tin plate? (See table following.)

	1 day.	4 days.	7 days.	1 month.	5 weeks.
Varnish film on linen...	1·34%	1·43%	1·80%	1·98%	2·0% absorption.
Varnish film on tin plate	0·228%	0·38%	0·45%	0·98%	1·34% „

Linseed oil films *do* allow moisture to pass through them, and this moisture is then absorbed by the cotton or linen, thus allowing the varnish film to absorb more. This process will, if conditions are favourable, go on until equilibrium is established between the amount of moisture in the atmosphere and that absorbed by the linseed oil varnish film and the linen or cotton.

It is interesting to note that the text-book just referred to also contains the following:—"When transformers are treated with linseed oil compounds, more care must be taken to prevent absorption of moisture than when the other class of compounds are used." Now, what object can there be in using linseed oil compounds when there are preparations to be obtained which do not contain this body and which, when employed intelligently, give very much better results?

The absorption of comparatively large quantities of water is not the only bad point about linseed oil and compounds containing this body. Experiments have shown that films of linseed oil compounds shrink as they age, and also that they chemically affect the copper conductors which they are supposed to assist in protecting.

For films of varnish on armature windings to shrink with age is not conducive to the long life of the armature. The shrinkage is not of sufficient magnitude to make itself visible to the naked eye, but is sufficient to allow of a very slight movement, due to centrifugal force, when the armature revolves. This will cause a very slight friction between the conductors and the fixed core parts, and will produce disintegration and weakening of the insulation, and, finally, a breakdown.

The following table shows the shrinkage in several linseed oil compounds, due to ageing. The films were prepared on linen, exposed to the atmosphere for two months to thoroughly oxidise, stoved at 100° F. for 32 hours, cooled and measured (column 1); then aged in stove at 100° F. for seven weeks, cooled and measured (column 2).

	1 Mils.	2. Mils.
Varnish composed almost entirely of linseed oil	11·9	10
Varnish containing about 15 per cent. linseed oil	10·5	9·8
Varnish free from linseed oil	8·2	8·2

The appearance of "green" on old coils is well known to all electrical engineers. This "green" is often called verdigris in mistake; verdigris is copper acetate, and as acetic acid, which is necessary for its formation, is not present under normal conditions in the conductor coverings, verdigris cannot form. The green compound is mainly the result of a chemical action set up between the fatty acids existing in the linseed oil used in the preparation of varnishes, and the copper conductors. It is a compound of copper and fatty acids of the linolic and linolenic series. To the chemist it is known as copper linoleate. Now ordinary, or raw, linseed oil may contain approximately 0·4 to 4·0 per cent. of free fatty acids, and "boiled oil" (boiled linseed oil), which is more often used in the preparation of varnishes, contains approximately from 6·5 to 16 per cent. of free fatty acids. Almost immediately the coils are varnished, these acids will begin to act upon the copper conductors, and their action will be accelerated by the absorption of water and the resulting electrolytic action. As the varnish film oxidises, the free fatty acids increase, and so the action on the copper conductors is further intensified. In course of time quite a thick layer of "green" is formed on the underside of the varnish film. Now where weak spots exist, the "green" will penetrate the film of varnish and open up channels for short-circuiting, by penetrating an adjacent film or coming into contact with some "green" which has worked its way through another wire covering.

Of the other sources of "green" on coils may be mentioned the acids of indefinite constitution derived from the pectin natural to the cotton used as wire covers, the acids occurring in shellac, and the acids of common resin.

Although cotton only contains a small quantity of acid bodies, it is quite sufficient to cause the formation of "green" on unvarnished insulation after it has been in use for some time, especially in damp situations, and a varnish which will

prevent this action should always be used. Varnishes which assist this action, like shellac and linseed oil varnishes, should be rigorously avoided.

On account of its lack of flexibility and rapid disintegration, combined with low dielectric strength, shellac varnish is rapidly falling into disuse, and when we add to these bad points the deleterious action which this varnish has on copper conductors with the production of "green," it seems surprising that electrical engineers have continued to use it so long.

In regard to resin, this material is rarely used alone, but is frequently dissolved in "boiled oil" in the preparation of linseed oil varnishes, to give a hard and glossy coat and to shorten the time of drying. As resin consists almost entirely of acid bodies, any varnish which contains it should be rigidly excluded from the winding shops. Resin itself is very brittle, and when it is added to varnish compounds it will not add to their flexibility; and on account of its acid nature it will assist in the production of "green" on the insulation.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Proposed Electrical Exhibition in Manchester.

Your correspondent "Another Manufacturer" appears to feel aggrieved at the suggestion of holding an Electrical Exhibition in Manchester, and enumerates certain reasons why such a course would be a great mistake. I should like to reply briefly.

1. The proposed Exhibition in Manchester will be held in a special building put up for the specific purpose of the Exhibition. It will be as much of a trade nature as the last Exhibition at Olympia, and other highly important trade exhibitions that are held there, and unquestionably more representative of the larger electrical manufacturing interests of this country. The site suggested is altogether a suitable one, having regard to space required, tramway and railway facilities, both for giving access to the grounds, and for the delivery of the various heavy exhibits on to the site. The fact that it is adjoining to, but not associated with, pleasure gardens containing "shooting galleries, &c.," on which your correspondent has duly enlarged, does not detract from the value of the site.

2. The recent Exhibition at Olympia was supported to a large extent by the supply companies, and I have reasons for stating that a feeling exists among this body that the results of that exhibition will be felt for some considerable time to come. Their support for the present exhibition, therefore, could hardly be relied upon. Manchester is in the centre of a very important locality for the manufacture of electrical apparatus, and is in the closest touch with many large towns in the immediate vicinity, in which large electrical manufacturing works are situated. The industrial area comprised within, say, a 30-mile radius from the Manchester Town Hall, is second in importance to no other district in the country. Further, only those who know the district are in a position to measure the tremendous strides that the application of electrical energy for power and lighting purposes is making.

3. Nothing can be gained by waiting until 1910, when a general industrial exhibition may or may not be held in this city. The scheme is altogether in the air at present. In any case, such an exhibition would not afford the electrical trade or the various supply authorities in the north of England an individual and distinctive exhibition, and the results would therefore not be of such a beneficial character. I pass over your correspondent's implied insinuation that a Manchester exhibition could not command "respect and attention."

4. Your correspondent's arguments under this heading are directed against exhibitions *per se*, and not to the one proposed to be held in this city in particular. I think the general consensus of opinion on the part of manufacturers is that if conducted on proper lines, and for mutual trade benefit, the outlay is invariably more than compensated for by actual business resulting, and by the stimulus given to business for some time to come. From the point of view of supply authorities, exhibitions are the best means at their disposal for bringing the advantages of the application of electrical energy before the public, and any new business resulting therefrom must in its turn bring grist to the mill of the manufacturer.

5. Far from its being "a-hole-and-corner arrangement," the interest of the "big firms" having works or directly represented in this district is assured, and they are by no means a small section of the general manufacturing interests of the country. On this point Mr. Longbottom spoke, apparently with authority, at a recent meeting of the Manufacturers' Association in London.

The Corporations of Manchester and Salford have decided to promote an exhibition, and it may be of interest to state that a meeting of representatives of some 125 electrical supply authorities in the North of England has been convened for the 24th inst. by the Lord Mayor of Manchester and the Mayor of Salford. It is understood that as soon as their patronage has been secured, the electrical trade will be invited to conferences to be held in London and Manchester for the purpose of electing their representatives on the Committee, and assisting the supply undertakings in promoting the scheme.

S. L. Pearce.

Manchester, *September 16th*, 1907.

[We have already expressed our views in favour of the proposed 1908 Exhibition at Manchester. We have not received sufficient evidence to lead us to believe that it will not have ample support from manufacturing and trading firms, nor have we any reason to suppose that the Exhibition will be organised on other than right lines.—Eds. E.R.]

I have read the letter signed "Another Manufacturer" in your issue of September 13th, and I must confess that I find myself opposed to the writer's views in their entirety.

The writer states that he disapproves of the idea of holding an exhibition in Manchester on the lines of that held in 1905 at Olympia, because—

1. The day is past when the electrical industry derives any benefit from being associated with shooting galleries, drinking bars, and military bands.

Surely this is not "fair comment." The last Electrical Exhibition at Olympia has generally been acknowledged the best and most representative Electrical Exhibition ever held in this country.

2. A much more useful exhibition could be held in a year or two's time in London, by the electrical branch of the engineering industry associating itself with the other branches, civil, mechanical, &c. Such an exhibition would command respect and attention, and would do us all good.

Your correspondent must be unaware of the Franco-British Exhibition in course of construction for 1908.

3. A general industrial exhibition is being mooted in Manchester for the year after next, which, if supported by the Lancashire manufacturers, as it will be, will be a very important function.

Would "Another Manufacturer" combine an Electrical Exhibition with the industrial exhibition mooted in Lancashire? Surely not; apart from the doubtful advantage, there is no available exhibition site in Manchester as it is, that can reasonably accommodate more than a fair proportion of the electrical trade.

4. The outlay (and it costs anything from £500 to £1,000 to make an adequate show in such exhibitions) is not at all commensurate with the benefit derived from it. Far better spend the money in pushing trade by other methods and be in a position to sell more cheaply through curtailing working expenses.

I have an entirely contrary experience, and can definitely trace increased prosperity as the result of the first Electrical Exhibition at Olympia. There is, in my opinion, no means so effective or so cheap of bringing new electrical inventions before the would-be interested parties.

I regret to find that I am so in conflict upon each point with "Another Manufacturer," but as the writer is screened behind a *nom de plume*, his remarks escape the respect which otherwise doubtless his "personality" would have engendered in the mind of

Herbert H. Berry.

London, E.C., *September 16th*, 1907.

Co-operation in the Electrical Trade.

I have read with interest your article on co-operative proposals for the electrical trade, and think that in so far as general advertising by means of a central showroom is concerned, the idea is an excellent one, and it would seem to me from inquiries made that there is every possibility of the manufacturer getting his goods brought before the notice of the purchaser at little or no expense to himself unless business results, and at much less than the average cost of obtaining business under existing methods. The call made upon manufacturers by supply undertakings, electrical contractors, and sales organisations such as the stores and other large furnishing houses, for goods on sale or return, are becoming a great tax, and the results, in so far as direct business goes, are rarely commensurate.

The exhibition of goods at a central Exhibition should ensure that they will be brought before the notice of persons intent on buying electrical apparatus, and the exhibits should be kept sufficiently up-to-date to interest the old and prospective consumer respectively. If the Exhibition is properly advertised and brought before the notice of the public, the advertisement to manufacturers would, in my mind, be of greater value than display cards in 'buses and on tramcars. The public interested in electrical matters, and those we want to interest, would have brought before them the latest and most up-to-date apparatus in a comprehensive manner. Most of the gas companies have showrooms filled with various makers' gas fittings and apparatus, but as there are comparatively few of these, and the name of electrical undertakings in London is legion, a complete co-operative showroom should, I think, certainly appeal to a large proportion of the electrical trade interested, at all events, in so far as London business goes.

As to rubbing shoulder to shoulder with one's competitors and their commodities every Exhibition necessitates this, and, in my opinion, the more one sees of competitors, the more one realises that they are not so bad as we have painted them in our imagination. Indeed, I would go further, and say that upon occasions I have been thrown directly into contact with my immediate commercial opponents, and the result has been in more than one instance that I have formed friendships which I can ill afford to spare, and I have yet to learn that the result has been to mutual commercial disadvantage.

I sincerely trust that Mr. Northcote will succeed in his effort, and unite the "whole industry" against its common foe.

Manufacturer.

The article under the above title has been awaited with interest by some, at any rate, of those who read the preliminary announcement referred to thereon.

One must confess to a feeling of disappointment now that the scheme is outlined, as it seems to ignore entirely what must be the essential principle of English publicity work, viz., differentiation of method to suit the many different "publics."

The subject is, of course, not by any means new, and the plan elaborated by Mr. Northcote follows very closely the methods of "The Co-operative Electrical Development Association" of the U.S.A., which, for its component members, has abundantly proved its value.

But the wholesale importation of American methods into England and the attempt to graft them into English organisations and businesses is not a success. *Vide* certain examples in the manufacturing and railway worlds.

This fact, however, proves nothing beyond the point mentioned above that the English public requires very different treatment from that of the States, as not only is it entirely different in its attitude toward most things, but it is not one public, it is of many layers and groups, all of which require quite different treatment.

This point hardly requires proof to those whose business lies in publicity work, as any traveller will tell you that his methods have to be quite different to induce Mr. McGregor and Mr. Evan Evans to buy the same kind of article, and every advertising specialist knows that different parts of the country and, in the case of supply authorities, different parts of the area, require very diverse methods if success is to result. For instance, it is useless to distribute the same pamphlet in a West End residential neighbourhood and in a block of tenements.

These somewhat elementary and obvious facts are insisted on, as they tend to show what may be possible sources of weakness in the scheme as outlined.

A perusal of some of the American schemes may not be useless in this connection, and a fairly full exposition of these is to be found in the issue of *Electrical Industries* for May 8th, 1907, including a summary of the History and Development of the "Co-operative Electrical Development Association."

This matter is probably familiar to most publicity men, but may not be so to all who are invited and expected to join in the new venture.

There is room for co-operation, but hardly along the lines indicated by Mr. Northcote.

"The basis of the proposal is the belief that the various interests in the electrical industry may benefit by adopting measures of a wholesale co-operative kind."

Possibly, but what hope is there at present of anything approaching unanimity of action among manufacturers, contractors, and supply authorities?

Even a cursory glance through the electrical trade journals will go to prove that there are at least four or five quite different causes and cures for the present "unsatisfactory" condition of different sections of the industry, which "unsatisfactory" condition is, by the way, extraordinarily difficult to locate.

Co-operative effort in its truest sense, and if it is to be finally beneficial all round, must end in some of the "vielzuviel" going to the wall, and who is going to be self-sacrificing and altruistic enough to stand on one side and be the "individual who shall be sacrificed for the good of the community?" Or will the wholesale traders squeeze the others out?

"An item in the programme would be a big permanent exhibition and showroom where contractors and others could go to see the goods of members of the organisation and make their selection."

M'yes. It is a somewhat novel idea to advocate a combined showroom for this purpose, or even with that as its chief object.

Surely that is served by trade advertisements and manufacturers' travellers? And if not, why not?

How on earth is a "big permanent exhibition," presumably in London, going to help a contractor in, say, Cork, to select the best selling lines for his public?

Will the "Wholesale Traders" pay his fare even once a year to come and see their showroom, or how do they expect to get him there?

On the other hand, if the showroom is to interest the general public, a single one, however large, will be just as utterly useless.

Has it ever occurred to the promoters to canvass the opinion of those who have, or have had or been had by, permanent and temporary showrooms?

Showrooms are necessary, however, but they exist already in great number, and where they are wanted, throughout the country, either those of individual contractors and manufacturers, or those of supply authorities, and though such a multiplicity may be bad for the manufacturer who is expected to send stock free to all and sundry, yet this is the only way to interest the lay public, who, if they have to take any trouble at all about a thing, simply won't.

You must take the article to the public; hence many showrooms, as only a small part of the public is in London.

Now which side is to have the pull here? Must the manufacturers co-operate or passively co-resist?

The writer has given a good deal of attention to publicity work, as it is his business, and it seems to him that publicity work must be more or less along individual lines, though there is a large field for common work in the supply of suitable literature from one common publishing centre for both manufacturers or supply authorities.

But let it be suitable and not futile. The practical value of such a paper as the *Bulletin* is very small, or at least it has proved so in most of the districts where the writer has made inquiries, but there is a large demand for semi-technical and technical literature for various purposes, which it is utterly impossible for each to publish for himself, and

which is only partly met by various publishing houses, and then there is no uniformity about the different productions.

As an example the following list is appended of some of the pamphlets and books found useful or used and discarded by the writer, together with an indication of their source, showing that here, at any rate, is an opportunity for co-operation in the production of advertising literature, which might well be undertaken by such a venture as the new Co-operative Society.

GENERAL.

List of Literature.	*Source.*
Bulletin.	Committee of London Supply Companies.
Popular Electricity.	Elec. Pub. Co., Ltd.
The Unit.	Elec. Press.

LIGHTING.

"Specific Reasons," &c.	Mr. C. Rockley, West Ham.
"Evidence from Users of Elec. Light."	*Elec. Times* offices.
The Effective Lighting of Shops.	"Scissored," and compiled by the writer.
Ditto. Houses.	
Ditto. Offices and Public Buildings.	
"Efficiency and Economy in the Use of Electricity."	The writer.

Also Manufacturers' trade literature.

HEATING.

"Gas *v.* Electricity."	Reprint from *Elec. Times.*
"Elec. Heating and Cooking."	*Electrician* Primers.
"Some Minor Applications of Electricity."	The writer.

POWER.

"Some Minor Applications of Electricity."	The writer.
Electrics.	Soc. of Power Co. officials.
"Adaptability of Elec. Driving."	Mr B. Longbottom's Paper, I.E.E.
"Lifts *v.* Hoists."	Mr. Crew's Paper, I.E.E.
"Elec. Driving in Building Operations."	Reprint from *Electrician.*
Elec. Lifts.	" ELECTRICAL REVIEW.
Rough Notes on Elec. Driving.	" " "
Elec. Driving in Woodworking Shops.	Pamphlets issued by well-known motor firm.
Elec. Driving in Printing Works.	
Electric Driving for Bakeries.	Another motor firm.

The above list is anything but complete, but it indicates the comprehensive nature of the literature required, and as the number of each kind is comparatively small for each district, individual effort here is misdirected.

On the other hand, for one central bureau to attempt to give cut-and-dried directions as to the methods to be adopted for publicity work in every district would be fatuous and useless, as each district requires to be "lived in" for some time before its "key-note" can be acquired.

By all means let us have co-operation in a broad sense, but a "ring" or central bureaucracy never.

J. A. K.

Alternator Test on Inductive Load.

We are interested in your article of September 6th describing test at ·85 power factor on Siemens alternators with Browett-Lindley's engines for the Great Cobar Copper Mine, Australia. In these tests the inductive load on the generator was obtained by the use of a second machine as synchronous motor which had been run up to speed by an auxiliary motor, the engine pistons of the second set having been previously removed.

This well-known method of obtaining an out-of-phase load was used for many years by a firm of engine-builders in Birmingham, at whose works a very large amount of such testing is done. The second machine was run up to synchronism by means of its own engine. This is much more convenient than removing the pistons and using an auxiliary motor, and the power factors obtained are sufficiently low on the load.

The method, however, has been in the last year entirely superseded in favour of a special apparatus recently brought out for this class of work—the Morcom & Walshe Inductive Load—for which our firm has the sole manufacturing licence. This load consists of a combination of special choking coils and water loads.

The synchronous motor method is in many ways convenient as regards the regulation of power factor, but a second set of sufficient size is not always or even generally available.

With the Morcom & Walshe load, power factors down to extremely low values, if required, can readily be managed at full K.V.A. without great expense, while both power factor and current are adjustable over a wide range.

Morris & Lister.

Coventry, *September 9th*, 1907.

The Draft Regulations of the Home Office.

I have read with much interest the criticisms of the electrical Press on the new Draft Regulations of the Home Office, but so far have seen no comments on Regulation No. 30, which provides for notices to be fixed on all motor users' premises, giving instructions on the treatment of persons suffering from electric shock.

The competition of gas and other engines, unhampered by fire office, B.O.T., and other rules, is already sufficiently keen, and it seems to me that if the B.O.T. rule prohibiting unauthorised persons from touching motors or apparatus was made more comprehensive and strictly enforced, other notices would be superfluous. This Regulation No. 30 will doubtless appear to many of the general public to brand the electric motor as a particularly dangerous piece of apparatus, and if this is necessary for electrical apparatus, then it is doubly necessary that every gas engine user, and particularly suction gas users, should have notices posted giving directions on how to treat cases of gasification, and the gas-using public generally on how not to find gas leaks with lighted candles.

Borough Electrical Engineer.

September 10th, 1907.

With reference to "£ s. d.'s" letter in your last week's issue, in which he is of opinion that a 3-ft. passage behind the high-tension switchboard of a 100-KW. station is ample, may I be allowed to say that the standard of 4 ft. is quite narrow enough. Let "£ s. d." put himself in the operator's place, and he will see that should he slip and fall in a passage such as he describes, there would not be much chance for him.

High tension is high tension, and whether a station is 100 KW. or 10,000 KW., whether it is run from dusk to daylight, or is on continuous load, such a passage would be dangerous to the operator.

Human life is of much more consequence than £ s. d.

Walter C. Green.

Ealing, W., *September 14th*, 1907.

Drawing-Office Lighting.

On page 406 of your current issue you have drawn attention to a method of lighting drawing offices by means of concentric light diffusers and give some American examples. It may be of interest to you to be informed that the drawing offices of the B.T.-H. Co., Ltd., at Rugby, are lighted with enclosed continuous-current B.T.-H. arc lamps using concentric light diffusers and lower shades, similar to the lamps described in your notes. The system has been in for several years and is quite satisfactory. It replaced a system of individual incandescent lamps.

C. L. Oechsner,
Manager, Publication Department.

Rugby, *September 14th*, 1907.

Electricity Supply to a Village.

I note the inquiries of "Water Power" in the current number of the REVIEW, and should be glad if he would communicate with me. I think it would be possible to light the village at considerably less cost than it will take for the 230 volts supply suggested, and give at least an equally good light. The charge for current would show a good profit at 3d. per unit.

I have two such installations working, and in each case

the current costs considerably less than 1d. per unit for fuel, &c. Another very small plant I am testing now has given more than 40 lamps of 8-C.P. at a cost of 1½d. per hour. This is a 1-H.P. engine (driven by town's gas), and the lighting is not direct from the dynamo, but through a storage battery.

The system is particularly adapted for villages or small towns and for overhead distribution on insulators. It is safe to handle; there is no danger from fire or shock.

Joseph Jackson.

Harrow, *September 11th*, 1907.

Direct-Current Compensated Voltmeter.

In your issue of September 6th I note a description of a compensated direct-current voltmeter. Surely this arrangement is not by any means new, as I have personally known of it for some seventeen or eighteen years.

Within only the last few months Messrs. Nalder Bros. and Thompson have made several of these voltmeters to the specification of my firm, with a further attachment by which a bell is rung whenever the volts vary from the standard by more than a pre-determined amount, which amount can be adjusted at any time by the engineer-in-charge by means of a key so that it cannot be altered without his knowledge.

Both arrangements are exceedingly useful for country stations where, during the daytime, the switchboard is not continuously under observation.

A. H. Dykes.

London, S.W., *September 12th*, 1907.

Three Methods of Electric Lighting.

We have been very much interested by the leading article on the above subject in your issue of September 6th, and are pleased to see that you draw attention to the great importance of systematic measurement and comparison, with a view to combating the statements made by the supporters of rival illuminants. We venture to think, however, that you are doing central station engineers an injustice when you doubt whether many are to be found who, as you express it, "hunt round with a luminometer." Judging from the number of orders and inquiries which we are receiving for Mr. Trotter's "Universal" photometer, it would appear that there are, or will be shortly, a very large number indeed, so occupied.

Everett, Edgcumbe & Co., Ltd.

London, S.W., *September 10th*, 1907.

OUR SPECIAL ISSUE.

The issue of the Electrical Review for next week, Friday, September 27th, will be a special one devoted to "Accessories and Fittings for Electric Light and Power." There will be many more pages of editorial matter than in usual issues, as we have for weeks been getting together a great deal of interesting matter relating to new and recently introduced manufactures in the lighting and power accessories and fittings departments. These will be published, with a very large collection of illustrations relating to them, on our special art paper. As in the case of former issues of this character, the needs of electrical engineers and other purchasers in the Colonies and foreign parts have been specially considered, as the Review has a large number of such among its regular readers.

In view of the large amount of matter that has to be handled in the production of this special number, it is necessary for our editorial pages to be closed somewhat earlier than usual. We shall, therefore, be glad if all our correspondents and contributors will forward *promptly* any matter requiring to be inserted in next week's issue. It may also be as well for those who have lately experienced any difficulty in obtaining their "Review" to, in this case, at any rate, order it direct from the Publishers, 4, Ludgate Hill, E.C.

BUSINESS NOTES.

Correction.—In the description of the double-sided power press of Messrs. J. Rhodes & Sons, Ltd., on page 416 of our last issue, we gave the address of the firm as Halifax. This was a mistake, the correct address being Grove Ironworks, Wakefield.

Dry Batteries.—The Electrical Power Storage Co., Ltd., announce to the trade that the arrangement whereby the E.C.C. dry cells (patent), and "Extra-Sec" cells, were sold exclusively by the General Electric Co., Ltd., is terminated.

They can now be obtained (wholesale only) direct from the E.P.S. Co., 4, Great Winchester Street, E.C., who are the sole makers, and who will send lists of prices and particulars on application.

The "Electromobile" Case.—It is reported that notice of appeal has been lodged by the plaintiffs, the Electromobile Co., Ltd., against the judgment of Mr. Justice Warrington in their action against the British Electromobile Co., Ltd.

The Turbines of the "Lusitania."—It is interesting to note that the turbines with which the *Lusitania* has triumphantly completed her maiden voyage were bladed on the system patented by Messrs. Willans & Robinson, the blades being built up in sections. The same is true of the *Mauretania*, the blades in her case being actually manufactured by that firm.

Catalogues and Lists.—Mr. A. Goldie Engholm, 30, Church Street, Birmingham.—New catalogue of C.B. circuit-breakers. It opens with a classification index of the various uses of these breakers, and proceeds in later pages to detail, with line diagrams and some good half-tones, the overload, overload and no-voltage, overload and underload, overload and reverse, no-voltage, underload, and reverse-current types for direct and alternating current work respectively. At one part of the book are given prices for magnetic blow-out devices and for loose handles, which prevent the circuit-breakers being closed against an overload or short-circuit. Several pages give complete diagrams of dimensions.

Liverpool Electric Cable Co., Ltd., Vauxhall Road, Liverpool.—New price list of electric wires and cables. The various sections are separated by means of a thumb index. Some new tables have been added in this issue embodying the recommendations of the Engineering Standards Committee as to standard sizes of solid stranded conductors. There is also a table extracted from the I.E.E. Wiring Rules, showing maximum currents, thicknesses of dielectrics, and insulation resistances, for insulated conductors. A further table shows the maximum current and number of lamps according to the rules of several fire offices. The list throughout is well arranged, and all prices are boldly brought out in red ink. Copies will be sent to anyone interested, upon application.

Mr. Archibald Campbell (sole agent for the Antacidine Co., Southall, Middlesex), 27, Chancery Lane, W.C. List of new insulating baking, and non-baking varnishes, and insulating paints. We understand that these are specialities in so far as their insulating properties are concerned, and also as regards their entire freedom from all acids. The Antacidine Co. have just started operations at Southall.

The Electrical Co., Ltd., 121-125, Charing Cross Road, W.C.—Trade leaflet showing some of their three and five-light inexpensive cord pendant fittings, and giving prices of same; leaflets relating to hand lamps, watertight china fittings, motor-car test and inspection lamps, and some special lines in Louis XV fittings. Also pocket list giving latest prices of Nernst lamps.

The Electrical Engineering and Maintenance Co., 49,

Lime Street, E.C.—Desk blotter showing some of their "Teemco" electric fans.

Messrs. W. Wadsworth & Sons, School Hill, Bolton.—24-page finely illustrated publication describing the "Wadsworth" electric lifts for passenger, hospital, dinner service and other purposes.

Endolithic Manufacturing Co., Ltd., Pomona Buildings, Fore Street, E.C.—Card relating to their name and instruction plates in ivory, ivorine, metal, brass, German silver, &c., as used by many electrical manufacturers.

The Concordia Electric Wire Co., Ltd. (now of 34, Queen Street, E.C., and whose address from October 1st will be 64, Salusbury Road, Kilburn, N.W.), have issued a four-page illustrated price list dealing with their flexible arm electric desk lamps, magazine fuses, and their patent tube and pipe bending machine.

Messrs. Newtons, Ltd., Taunton.—Pocket list giving a specification, and tabulatd details and prices and dimensional particulars, of their dynamos and motors.

The Wilson-Wolf Engineering Co., Ltd., Thornton Road, Bradford.—New catalogue of standard direct-current dynamos and motors, giving full illustrated descriptions, specifications, and technical data enabling the outputs of semi-enclosed, ventilated enclosed and fully enclosed motors to be calculated. Fully dimensioned drawings, prices of extras and spare parts, and shipping weights and packing, are also given. The list has been compiled with the view of facilitating the work of estimating on the part of engineers, contractors and shippers, &c. Standard machines can be supplied from stock. Copies of the catalogue may be obtained on application.

Messrs. James McMillan & Co., of Glasgow, and Clun House, Surrey Street, Strand, W.C.—Catalogue of 150 pages particularising the various manufactures in telephones, switchboards and accessories of the Elektrisk Bureau, Ltd., of Christiania. The ground covered by the book, which is well illustrated and indicates prices, is best indicated by mentioning the different sections, which are:—Wall and table telephones, portable telephones, mining and special telephones, battery and intercommunicating telephones and switches, switchboards, multiple boards and accessories, lightning arresters, microphones, receivers and micro-telephones, extension bells and switches, generators, accessories, cords, and diagrams of connections. A loose sheet gives particulars of the "Eirophone," a telephone set for the use of those who suffer from deafness.

Messrs. J. H. Holmes & Co., Newcastle-on-Tyne.—New and revised list of electrical measuring instruments just issued, showing and giving prices and particulars of the "Castle" moving coil and spring-controlled ammeters and voltmeters, portable testing sets, "Sector" moving-coil instruments, and combined galvanometer and battery.

Electrical Manufacturing in the U.S.A.—"The business of four large electrical companies for the first half of the year contains no justification for the somewhat disturbing reports of a dropping off in business and a wholesale reduction of working forces. The General Electric Co. booked over $35,000,000 of orders in the first half of the present fiscal year, compared with about $29,000.000 in the same period of 1906. Western Electric gross for the first six months of the current fiscal year was about $30,000,000, or $1,000,000 less than for the same half of last year. Westinghouse officials estimate shipments for the current year, based on the results of the first five months, at over $42,000,000. The Allis-Chalmers closed its year June 30th, and gross receipts are understood to have been approximately $20,000,000. It is, of course, probable that in the event of any general let-up in business, new orders for electrical apparatus will drop off in the last six or seven months of the current fiscal year. At the same time the General Electric, Westinghouse and Allis-Chambers each has orders booked ahead sufficient to keep the shops in full operation for five or six months. Based on actual results for the first five or six months of the present fiscal year, and assuming that in the current year Allis-Chalmers does no greater business than during the 12 months just ended, the gross earnings of the four companies would work out at the following rate:—

	Present fiscal year.	Previous fiscal year.
General Electric	$70,000,000	$60,071,883
Westinghouse	42,000,000	33,026,240
Western Electric	60,000,000	69,245,331
Allis-Chalmers	20,000,000	20,000,000
Total	$192,000,000	$182,343,454

"The gross receipts of the four companies show an increase of nearly $10,000,000, or over 5 per cent. over the previous year."—*Electrical World.*

Nernst Lamps.—In a letter to the *Electrical Contractor*, the A.E.G. English Manufacturing Co., Ltd., state that although they have informed contractors in various towns that they are willing to fit their new improvements to existing lamps free of charge, the contractors will not take the trouble to advise their clients to have this done. On the other hand, municipal electricity supply authorities have readily taken up the matter, and have induced a large number of consumers to accept the company's offer. The company's inspectors have found that ½-ampere burners are used on 1-ampere lamps, or with 1-ampere resistances, that the holders of B and D lamps are not slotted, and that Luna and A lamps are connected with the wrong polarity, a state of affairs discreditable to the contractors, and fatal to the good working of the lamps. Moreover, the contractors apparently refuse to co-operate with the company, although the latter undertake to hand over any orders their travellers may take to the contractors, and to refrain absolutely from quoting trade terms to private users. We do not know what the contractors have to say to all this, but it certainly looks as though they were neglecting their own interests, as well as injuring the company. How can the competition with gas be carried on under such conditions?

Educational Notes.—South-Western Polytechnic.—We have received the calendar and prospectus of this college for 1907-8, giving particulars of the day and evening classes. Mr. A. J. Makower is the head of the electrical engineering department, in which a full course of scientific and practical instruction is given. Facilities are provided for candidates for the B.Sc. examination of the London University. The day classes open on the 30th inst., and the evening classes on Monday next.

Northampton Polytechnic Institute. — The "Announcements" for the session 1907-8 have just been issued. Day and evening courses are provided in Mechanical and Electrical Engineering, Technical Optics, Horology, &c. The day classes commence on the 30th inst., and the evening classes on the 23rd inst. The principal, Dr. R. M. Walmsley, is head of the Electrical Engineering Department, associated with Dr. C. V. Drysdale, and Mr. H. M. Hobart lectures on Electrical Engineering Design. A special feature this year is a course on the production and measurement of light.

Trade Announcements. — Messrs. Norton and Gregory, Ltd., Castle Lane, Buckingham Gate, S.W., have acquired the business hitherto carried on by the Architects' and Engineers' Supply Association, 4 and 5, Dean Street, High Holborn, W.C.

The Western Electric Co., of 171, Queen Victoria Street, E.C., are on September 30th, removing their London office to Norfolk House, Victoria Embankment. The firm's P.O. telephone number will remain as heretofore, No. 2389 Central, but the National number will be changed to Gerrard 5349.

Messrs. Mawdsley's, Ltd., of Zone Works, Dursley, Glos., inform us that they have appointed Messrs. D. M. Malloch & Co., 50, Wellington Street, Glasgow (Telephone No. 2175; telegrams "Cryselco") as their agents for the West of Scotland.

Messrs. Imeson Bros., Finch & Co., Stockton-on-Tees, have taken over the sole agency for the British Isles for the American Sun Electric Lamp.

Australian Copper.—According to the returns published by the Mines Departments of the leading Australian States, says the *British Australasian*, their copper output for 1906 was as follows:—

	Copper. Tons.	£
New South Wales	9,755	789,527
South Australia	8,208	718,609
Queensland	10,077	916,546
*Tasmania	8,400	800,000

* Approximate.

"The value of the exports during 1906 has been given at £3,000,000, which is less than the total of the figures stated above, but valuation for export purposes is always fairly low."

Improved Wall-plug.—One of the disadvantages of the common form of wall-plug, in which the flexible enters at the centre of the plug, is that the flexible can so easily be used as a handle for pulling the plug out of the socket; moreover, repeated bending takes place at the orifice and the two insulated conductors are closely apposed at that point, so that the conditions are favourable to short circuit. If such a short occurs at the moment when the plug is pushed into the socket, unless the fuse acts promptly, one may receive a very nasty burn. To remedy this, says *l'Industrie Electrique*, M. G. Goisot has devised a plug in which the two conductors are separated by a wall of porcelain and leave the plug by separate holes. Further, the latter are not in the face of the plug but in the periphery, so that the flexible no longer serves the purpose of a handle; it is also less liable to bending, as it hangs straight downwards from the plug. The cap is attached by screws.

Annual Outing.—The annual outing of the Linolite Co. (works and office staffs) took place on Saturday, 14th inst., the party being accompanied by Mr. A. S. E. Ackermann (engineer to the company), and Mr. R. L. Matthews (assistant manager). The party went for a trip to Southend, where, after dinner provided at the Marlborough Hotel, a cricket match was played between the office staff and the works staff, the former beating the latter by 16 runs.

Exhibition.—An exhibition of electrical appliances, lamps, &c., was opened on 16th inst. at Loughborough, Leicestershire, and will remain open for one week. The Edison & Swan United Electric Light Co., Ltd., of 36-37, Queen Street, E.C., state that, although they have not taken a stand there, they are showing in operation four of their new 10-ampere size white flame Ediswan-Carbone lamps, as well as two of their new enclosed arc, the "Radiant," which is also one of the white light type, although not a flame arc. In connection with the remarks made at a recent meeting of gas engineers by Mr. J. H. Canning, of Newport, in which he stated that flame arcs threw off poisonous fumes, became corroded by the volatilised salts condensing on the mechanism, burned costly carbons, and emitted a light of unpleasant hue, thus making four definite charges, the Ediswan Co. inform us, in reply, that their Ediswan-Carbone white-flame type throw off no poisonous fumes, do not corrode, burn pure carbons of inexpensive nature, and give a light the spectrum of which is exactly similar to daylight. It is generously suggested that Mr. Canning should visit the Ediswan

showrooms and become acquainted with these flame arcs. We can guarantee him the most charitable reception possible under the circumstances.

Dissolutions and Liquidations.—Andrew Matson, electrical engineer, Hardwick Terrace, Stockton-on-Tees.—First meeting September 24th, at Middlesbrough; public examination, October 23rd, at Stockton-on-Tees.

The Victoria Garage and Electrical Co. (H. Lewarne and E. J. Swift, electrical and motor engineers), St. John Street and Parkside, Coventry.—Partnership dissolved from September 10th. E. J. Swift attends to debts.

Bankruptcy Proceedings.—G. A. Benton, electrical engineer, Hatherton House, Shareshill, Staffordshire (formerly of Muswell Hill).—Supplementary dividend of 2s. in the £, payable September 25th, at the Official Receiver's office, Wolverhampton.

Book Notices.—*Die Montage Elektrischer Licht und Kraftanlagen.* Ein Taschenbuch für Ingenieure, Elektromonteure, Installateure and Beitzer elektrischer Anlagen. By H. Pohl. Hanover: Dr. Max Jänecke. Price 2 M. 40 pf.—This second edition of the first volume of the "Bibliothek der gesamten Technik" gives a clear though superficial descripton of most of the problems met with in electrical installation work. It is divided into 24 chapters dealing with direct and alternate current generators, motors and transformers, accumulators, instruments, mains, cranes, lamps, theatre lighting, ship lighting, electricity in mines, and installations in damp or gas-laden atmospheres. The illustrations are good and plentiful and the information given is generally reliable, although, owing to want of space, it has usually to be given in the form of a bald statement without much explanation. This lends conciseness to the book, and would prove no objection, provided that quite definite rules were laid down in each case. When, however, the various methods of carrying out a given class of work are described without critical comparison, as is the case in some of the chapters, the result is likely to be more confusing than helpful—at least to beginners.

"Transactions of the South Yorkshire Association of Mining Students." Vol. II, No. 4. London: Chichester Press.

"The Corpuscular Theory of Matter." By J. J. Thomson. London: A. Constable & Co., Ltd. 1907. Price 7s. 6d. net.

"Electric Power-Users' Handbook." By P. Hunter-Brown. London: Hodder & Stoughton. 1907. 5s. net.

A Limehouse Factory Installation.—The contract for the electrification of Messrs. C. & J. Webb's factory at Limehouse has just been carried out. It consists of the installation of 11 direct-current 480-volt motors, driving sewing, button-holing and bar-tacking machines, for the manufacture of uniforms, &c. The work has been done by the Electrical Engineering and Maintenance Co., of Lime Street, E.C., in conjunction with Messrs. Jones's Sewing Machine Co., Ltd., who contracted for the mechanical equipment and transmitters. The work has been carried out to the specification, and under the personal supervision, of Mr. T. Kerr-Jones, the company's consulting engineer. It is in accordance with the new Home Office Factory Regulations. We understand that the adoption of electric driving has enabled the speed of the machines to be raised to three times the old value, and the perfectly steady running obtained has been found of great advantage. In consequence of the speeding up, the output of the factory has been enormously increased. Power is taken from the Stepney Borough Council's mains at 1d. per unit.

Oil and Waste-Saving Machines.—Mr. Chas. Pullan, of Cardiff, has lately received orders from the following firms for oil and waste-saving machines for which he is sole agent in South Wales:—Guest, Keen & Nettlefords, Ltd., Ebbw Vale Steel, Iron, and Coal Co., Ltd., Lockets Merthyr Collieries, Ltd., Insoles Cymmer Collieries, and the Borough of Newport Electrical Department.

Rubber.—The *Tribune* says that in the course of his report on the Federated Malay States, the High Commissioner refers to the great strides which rubber planting has made during the past year. The area under rubber cultivation has increased from 38,000 acres in 1905 to 100,000 acres.

LIGHTING and POWER NOTES.

Ashton-under-Lyne.—The B.G. has decided to provide its own E.L. plant, at an estimated cost of £2,000. This will give a saving of about £80 per annum in the cost of energy, based on 2½d. per unit, the present charge made by the T.C.

Barnstaple.—The report of the chartered accountant engaged by the T.C. to audit and report upon the accounts of the municipal electricity undertaking, from the inauguration of the works in 1902 to March 31st, 1907, was, on Friday, placed in the hands of the members of the T.C. Appended to his remarks are three tabulated statements. The first is a revenue account going over the whole progress of the undertaking, and showing a loss (exclusive of losses on the installation) of £1,559 14s., and, in addition, a sum of £270 18s. is added, as being improperly charged to capital account, making a total loss on the revenue account of £1,830 13s. Sale of energy amounts to £13,445, of which no less than £6,330 9s. has come out of the rates since 1902 for public lighting. The record statement is "an account of capital expenditure as amended after investigation," and showing a total sum under this head of £31,165 7s., against £31,616 12s. in the previous accounts, or a difference of £451 4s., which it is considered should not be charged to capital. The third statement is a balance-sheet at March 31st, 1907, as amended after investigation of capital expenditure from the commencement, and showing that there is due to the treasurer (revenue) £3,017 13s., as a set-off against which, however, there are bills outstanding and stock in hand, so that the dead loss is no more than the sum of £1,830 13s. previously stated. A most serious point in the report is the question of depreciation, which, the auditor insists, must be faced, the only alternative, in his opinion, being to find the borough "burdened with an ever-increasing debt caused by the replacing of worn-out capital assets, and necessitating a heavy call upon the rates each year to meet the deficiency resulting from the increased interest and instalments on loans."

Bo'ness.—At the Valuation Court of the County of Linlithgow last week, the Bo'ness Corporation (owners of the works), with the National Electric Construction Co. (lessees), appealed against an assessment of £1,300, which had been placed upon the electric supply undertaking. Mr. Spencer Hawes, of Caxton House, Westminster, who gave evidence on behalf of the appellants, claimed that the assessment was so excessive that it could not have been founded on the recognised "revenue" principle. Although a strict valuation on the "revenue" principle supported a much lower figure, the appellants were prepared to agree to a value of £400 for the current year. Mr. Hawes showed that this figure was fully supported by the valuations fixed in the cases of the Scottish electrical undertakings at Hawick and Coatbridge. In the end the Court reduced the assessment from £1,300 to £720, but the appellants declined to accept this, and gave notice of their intention to take the appeal to the higher Court. It was acknowledged that the assessor's valuation had been founded on the "contractors'" principle by a percentage on the constructional cost, notwithstanding that the Appeal Courts had adopted the "revenue" principle in several cases, notably in connection with the Falkirk gas works, and the electricity works at Edinburgh, Hawick and Coatbridge.

Canada.—Ottawa.—The purchase of the Chelsea water power, near Ottawa, which is capable of developing 25,000 H.P., for the sum of $200,000, has been recommended to the City Council. With regard to this power, the total cost would be for 10,000 H.P., $868,000; for 20,000 H.P. the cost would be $1,286,000. The engineers propose that the city should acquire half of the rights and bear one-half the cost of headworks; the annual cost per horse-power for 10,000 H.P. would be $11.60, and for 20,000 H.P. development, $6. The head works would cost $350,000. There are several other available powers within 28 miles of Ottawa.

Carmarthen.—The T.C. on September 11th decided, by 12 votes to 8, to seal the agreement with Messrs. Saunders & Co., of Cardiff, to supply current to the town for street lighting for a period of 14 years.

Clyde Valley.—Electrical power is a prominent feature of the new yard of Yarrow's now being laid out at Scotstoun on the Clyde. Electric cranes are specially noticeable. Over the fitting-out basin, with a span of 93 ft., there is a 50-ton travelling crane, and another one of similar size in the engineers' shops, along with smaller electric cranes. The boiler shop has a 50-ton and a 10-ton crane. On the space between the boiler shops and the platers' shop a large gantry is placed, 330 ft. in length, with an 85 ft. span, carrying a 7-ton electric travelling crane. A feature of the pattern-makers' and joiners' shops, is that the machinery will be driven by electric motors placed under the level of the floor. All the power will be obtained from the Clyde Valley Electric Power Co., and all the works are to be lit by electricity.

Continental Notes.—Switzerland.—Recent statistics show that in Switzerland there are 494 electricity works, of which, however, 208 are wholly, and 41 partially, fed from other stations. Taking 163 works of which full data are available, *l'Industrie Electrique* shows that 89, of 74,381 KW., are hydraulic; 56, of 70,908 KW. hydraulic, with steam plant in addition; 3, of 1,110 KW., steam; 14, of 1,089 KW., gas; and 1, of 1,870 KW., steam and gas. The average power is 837 KW.; that of the hydraulic plants alone, 1,270 KW., and that of the steam plants, 370 KW.. the gas plants averaging only 78 KW. Direct current is supplied by 63, alternating by 115, and both by 31. Three stations have an output exceeding 10,000 KW., 5 exceeding 5,000 KW., and 12 exceeding 1,000 KW. Of 207 stations, 182 supply motors only, and 30 of these only during the daytime. There are 100,000 consumers, of whom 10,800 take power and 81,500 light, the remaining 7,700 using electricity for heating.

Germany.—Plans are being prepared in connection with a project to establish a municipal central electric lighting station in the town of Wermelskirchen, Rheinland.

Devonport.—An electrical exhibition was opened by the Mayor, on the 12th inst. The exhibition is replete with electrical power and lighting appliances, electro-medical apparatus, electric cooking, and photographic devices, &c.

Dundee.—The Harbour Trustees have approved of the plans of the routes for the cable tracks in connection with the new power station to be erected at Dundee, and they have also approved of the conditions under which the cables will be laid.

Edinburgh.—The Electric Lighting Committee of the T.C. has decided to recommend the Council to reduce the rate per unit by ½d. to ordinary consumers. Should the Council adopt the recommendation, the price per unit will be 2¾d.

Farsley.—The draft agreement for the transference of the Council's electricity undertaking to the Electrical Distribution of Yorkshire, Ltd., has been agreed to by the U.D.C.

Heston and Isleworth.—The U.D.C. has reduced the charges for energy, in respect of arc lamps for outside lighting, to 3d. per unit, from 5d. per unit. A long debate recently took place on a motion by Councillor Greville Smith to form a special committee to investigate the Council's electric light undertaking, with a view (*a*) to leasing or selling the concern at the best figure; and (*b*) to report fully upon the condition of the whole concern and its future prospects. The matter was deferred.

India.—Cawnpore.—In a recent issue we referred briefly to the new electrical plant and tramways in this city, for which Messrs. Crompton & Co. were the contractors. The power station is situated centrally and has a capacity of 855 kw. The boiler house contains three marine type Stirling boilers, with an evaporative capacity of 6,000 lb. water per hour, and fitted with superheaters and chain-grate stokers. The feed heaters and pumps are placed in a separate room, the pumps being motor-driven. In the engine room are installed a 375-kw, two 165-kw., and two 75-kw. units, consisting of 450-550-volt Crompton generators, suitable for either lighting and traction, and coupled to Belliss high-speed engines. Two batteries, one for lighting and one for traction purposes, have been installed, the latter being worked in parallel with the generators in conjunction with a Crompton automatic booster, and the former, in connection with a reversible booster. The switchboard is placed in a separate room to protect the attendants from excessive heat. Some seven miles of lighting mains, on the three-wire system, have been laid. The cables are laid on the solid system, 4 ft. below the surface, to guard against temperature changes, the range being from just above freezing to 150° F. In order to reduce the cost of house services, the houses being surrounded by compounds, the service cables are carried up a pole and then overhead to the houses. Some 3½ to 4 miles of tramway track have been installed, the overhead work being of normal type, and a car-shed to accommodate 40 cars has been constructed. The cars are of the single-deck type with Dick, Kerr equipments.

Llansamlet.—Swansea R.D.C. had decided to apply to the B. of T. for a prov. order for E.L. at Llansamlet.

London.—Shoreditch.—Application is to be made to the L.C.C. for sanction to borrow £6,444 to cover the cost of works already carried out in extending mains and laying service pipes. Two arc lamps are to be used for the lighting of Whitmore Bridge, replacing three gas lamps.

St. Pancras.—The quarter's output of electricity (ending June 30th) was 1,404,533 units, which compares with 1,533,142 units in the corresponding period of last year. The decrease is due to a reduction in power units (280,369 as against 475,056 in 1906) supplied for the constructional operations on the tube railways.

Camberwell.—An inquiry was held by the B. of T. at the B.C. offices on July 30th into the subject matter of the appeals of the County of London Electric Supply Co., Ltd., against the usual conditions (that the mains be used only in respect of the supply of electricity within the borough) imposed by the B.C. in respect of mains in Lisford Street and Sumner Road. The Committee is now in receipt of a letter from the B. of T. allowing the appeal of the company and approving of the proposed works.

Fulham.—Mr. Carson Roberts, the district auditor, makes the following entry in his report on the accounts of the B.C. for the year ended March 31st last:—"Statement of reserve funds—electricity accounts. I am pleased to note that the Council has resolved to allow no further entries of a misleading character to appear in the published abstract of its accounts or in the returns to the Board of Trade in regard to non-existent reserves." The Borough Council is to apply to the L.C.C. for a loan of £7,330 for electric lighting purposes.

Ossett.—The T.C. has consented to the Yorkshire Electric Power Co. supplying energy to mills in the town, subject to the right of the Council to withdraw its consent on six months' notice, and to the company paying the Council 5 per cent. on the receipts for energy sold.

Portslade.—The Joint Committee for Portslade, Southwick and Shoreham U.D.C.'s has decided to take counsel's opinion on the terms proposed by Brighton T.C. for supplying energy to the district.

Redditch.—The U.D.C. has decided to procure 200 64-c.p. Osram lamps for street lighting, to replace ordinary 32-c.p. incandescent lamps.

Scottish Private Installations.—An important installation has just been completed at Dunrobin Castle, Sutherlandshire, by Messrs. Claud Hamilton, Ltd., Glasgow, under the superintendence of Mr. Thomas Young, M.I.C.E. The generating plant consists of two large suction gas engines coupled to multipolar dynamos; a storage battery is also installed in an adjoining room. Underground cables are carried from the engine house, into the castle, the laundry, and the estate workshops. In lighting the castle it was specially desired by the Duchess of Sutherland that the magnificent candelabra in the dining and drawing rooms and on the staircase should be retained, and these have been adapted by replacing with electric lamps of exact shape and colour the wax candles formerly used. All the ventilating fans are electric-driven, and the hot plate near the dining room is also electrically-heated.

Another north of Scotland mansion, which has been fitted up with electric power and light by Messrs. Claud Hamilton, is Langwell House, Berriedale, belonging to the Duke of Portland.

Swindon.—The T.C. has decided to undertake the sale of electric lamps to consumers at retail market prices.

Wednesbury.—Mr. H. R. Hooper, of the L.G.B., held an inquiry on Wednesday respecting an application by the Corporation for sanction to borrow £10,000 for the purpose of laying down a complete plant for the generation of electricity in the borough. Mr. Hayward, on behalf of the Midland Power Co., strongly opposed the application, urging that it would not pay the Corporation to generate its own electricity; and he further pointed out that, in that case, the present agreement between the company and the Corporation would be liable to be determined. The result of that would be that there would be three concerns which would have the power to supply electricity in the borough of Wednesbury—the Corporation, the Midland Power Co., and the Mond Gas Co. After a lengthy hearing, the Inspector promised to make his report to the Board in due course.

Yardley.—It is stated that the U.D.C. has practically decided to work its own electric lighting order, no agreement as to its transference having been arrived at with the Birmingham Corporation or Shropshire, Staffordshire and Worcestershire Power Co. It is proposed that the South Yardley power station of the B.E.T. Co. should be purchased and removed to a more convenient site and that the Council should take over the tramway supply.

TRAMWAY and RAILWAY NOTES.

Argentine.—The Belgian Electric Tramway Co., which took over the Roux Tramway concessions, is petitioning the Municipal Council of Buenos Ayres for an extension of, at least, two years for the termination of the works that ought to conclude December 31st, 1907.

Blackpool.—In order to contradict certain published reports, Alderman Brodie, of the T.C., has issued a statement in reference to the recent arbitration with the Lytham and St. Annes Tramway Co. What he wishes to contradict, he states, is the misleading story circulated as to the cost of the arbitration. It had been said that the Corporation's costs would amount to between £500 and £600, when, as a matter of fact, they were no more than £60.

Bradford.—The Corporation, last week, opened a six-mile railway between Pateley Bridge and Lofthouse, at the foot of Great Whernside. Although primarily constructed to facilitate work on the Corporation's storage reservoir, the line is available to passengers, and will be operated by old Metropolitan rolling stock. As the line is a single one with passing places, the electric tablet system of working has been adopted.

Continental Notes.—Bavaria.—It is announced that on the re-assembling of the Bavarian Parliament at the end of this month, a Bill will be introduced to authorise the conversion to electric traction of the State Railway between Salzburg, Reichenhall and Berchtesgaden. There are many gradients on this particular line which is said to have prospects of being remunerative. It is proposed to obtain the power for working the railway by the utilisation of the river Salzach, which is expected to yield 5,000 h.p. A vote of funds will afterwards be demanded for the transformation of the railway between Munich, Starnberg, Garmisch, Mittenwald, Kitzing and Kochel. It this case it is intended to utilise for power purposes the water of the Walchensee and of the Isar and the Rissbach.

Switzerland.—The Swiss confederation is seeking to secure possession of water falls for the purpose of supplying power for the eventual working of the State railways by electricity. An agreement has just been concluded with the Canton of Uri, whereby the confederation comes into possession of considerable water power in return for the payment of a single sum of £10,000 and of £2,800 per annum as "interest on water." An arrangement of a similar kind was made with the Canton of Tessin a little time ago on the basis of a payment of £12,000 and of £3,800 yearly as water interest. By this means the confederation has obtained rights over waterfalls representing over 50,000 h.p., and it is therefore assumed that the work of introducing electric traction on the railways will now be taken in hand.

Spain.—La Sociedad Hidro-Electrica del Chorro is establishing a new sub-station in Malaga for transforming electrical energy from 2,500 volts (three-phase) to 550 volts. The plant to be put in will, at first, comprise a 500-h.p. rotary transformer, the current being intended for the operation of the electrical tramways in the town.

An electric tramway has just been completed and put in operation

in the town of La Loma. An application has also been made for a concession to continue the line from Balza to Linares.

Austria.—La Société des Tramways d'Agram, of Agram-Austria, has, after long negotiations, completed arrangements with the municipal authorities of the town for the conversion of its tramways to electric traction. Under the terms of the agreement the company's concession will be extended for a term of 50 years from the day the first electric line is put in operation. The company undertakes to convert its present system and to construct two additional lines, which will bring the length of the system up to 20·4 kilometres. The town will construct the power generating station, which will also be utilised in connection with the public and private electric lighting, and will supply the necessary energy for the operation of the tramway at 14 hellers (1·4d.) per kilowatt-hour, up to 700,000 kilowatt-hours, and 12 hellers per kilowatt-hour over that quantity. The town will take 4 per cent. of the gross receipts for the first 10 years, 4½ per cent. in the next 10 years, and subsequent similar periods in proportion, up to 6½ per cent. Overhead conductors are authorised for the whole system, but steel masts are obligatory only within the town limits.

Holland.—The following applications for concessions to construct electric tramways have been made to the Dutch Government: (1) W. E. Cramer & Cie., Arnhem for Arnhem and surrounding district; (2) Lups & Co., Velp, from Velp to Dieren; (3) Koron to Venhuizer and Ewijck to Schagen (Syndicate).

Dalkeith.—The T.C. has been somewhat exercised concerning the fate of the electric tramway undertaking which was to be laid down between Edinburgh and Dalkeith. Recently the town clerk of Dalkeith wrote to the secretary of the syndicate inquiring what progress was being made with the scheme for beginning the electric tramways between the Edinburgh city boundaries at Nether Liberton and Dalkeith and Eskbank. The secretary has replied that arrangements for financing the undertaking are still under consideration, and until these have been satisfactorily concluded he is unable to give a definite reply.

Edinburgh.—The Tramways Committee has decided to recommend the Council to take estimates for the whole work required for the cabling of the East Claremont Street route. The recommendation has been made in order to have definite data for the calculation of the extra cost to the city.

Leeds.—At a meeting of the Tramways Committee on the 16th inst., it was decided to recommend that sanction be obtained for the borrowing of £40,000 for the construction of tramways in Otley Road, from the Three Horse Shoes to Lawnswood, in East Street, and in South Accommodation Road.

Liverpool.—An electric tramway car proceeding slowly up Prescot Street, one of the steepest gradients in the city, on Saturday morning suddenly stopped, and then began to run backwards. As it gained speed the passengers jumped off, several being hurt. The driver and conductor stuck to their posts, and succeeded in stopping the car before it reached the bottom of the incline.

London.—L.C.C.—The London County Council has sent a circular letter to the Metropolitan Borough Councils suggesting that electric mains under carriage-ways should be laid at a minimum depth of 3 ft. 6 in., where there is any likelihood of a tramway being constructed, or where street improvements may be necessary.

The Highways Committee of the L.C.C. is asking the consent of the Borough Councils affected to the introduction of a Bill in the next session of Parliament for connecting the existing tramways in Blackfriars Road with those in Southwark Bridge Road, *vid* Southwark Street.

Poplar.—In response to an inquiry by the B. of T., as to the B.C.'s position in regard to the adoption of the "G.B." system on the Aldgate-Bow route, the B.C. has stated that it has no objection to the adoption of any system, provided the scheme affords through-running facilities between Aldgate and the districts of West Ham, East Ham, Ilford, &c.

London United Tramways.—The President of the B. of T. is to be asked to receive a deputation from the Councils of Hammersmith, Ealing, Hampton Wick, Hanwell, Teddington, and Twickenham, with regard to the noise caused by the tramcars of the London United Tramways Co. The Teddington U.D.C. some time ago asked the B. of T. to cause an inspection to be made by one of its inspectors of the tramway track in Teddington under the provisions of Sec. 27 of the London United Tramways Act. The Board replied that it was not disposed to order an inspection unless action had first been taken against the company under the first part of the section, and such action had failed on the evidence then available.

Musselburgh.—It was reported at a meeting of the T.C. that the cost for the extra policing of the town during the tramway strike disturbances was £120, while a claim from the tramway company for damage to their property amounted to £220. Included in this latter sum was £84 as the account of a local purveyor for housing and feeding the "blacklegs"; the replacing of the windows and other glass broken cost £64, and £11 was charged for refreshments for policemen on the cars and for drivers and conductors. The claim was remitted to the Provost and Law Committee.

Northfleet.—A serious delay to traffic recently happened through the fusing of one of the overhead wires on the tramway between Swanscombe and Northfleet. The trouble commenced with the breaking of a guard wire, which fell across the trolley wires, and one of these fell on to the roadway near a rail, where the road had been freshly tar-sprayed. A large area of the road surface was speedily alight, and it was two hours before the traffic could be resumed.

Perth.—The T.C. has refused to adopt the Lord Provost's motion to appoint a committee to report as to what should be done to make the tramways pay. The appointment of such a committee, it was contended, would be a vote of censure on the present Tramway Committee.

Portsmouth.—The T.C. has sanctioned extensions to the municipal tramways, estimated to cost £33,876.

South Africa.—Durban.—The Mayor has suggested that the Council should negotiate with the Government with a view to extending the tramways, electric supply and telephones to the suburbs within a radius of 10 miles.

Stockport.—In reply to the Stockport Architects' Association, the Corporation of the town has stated that it is its intention to adhere to the decision to proceed with the competition in respect of the designs for the new tramway offices. Mr. G. H. Willoughby has been appointed assessor, and a plan of the site at Mersey Square is now prepared.

U.S.A.—New York.—With a view to determining the type best adapted to haul its heavy passenger trains through the New York tunnels, the Pennsylvania Railroad has in progress a series of experiments with electric locomotives. On its West Jersey and Seashore division and on the Long Island Railroad, two direct-current heavy type locomotives have been put in service. One of the locomotives weighs 77¾ tons, and is equipped with four motors, aggregating 1,400 H.P., which drive the wheels through single-reduction gears; the other locomotive weighs 87 tons, and is equipped with motors aggregating 1,240 H.P., which drive the axles direct.

Victoria.—Geelong.—The T.C. has unanimously decided to accept proposals of the Electric Light and Traction Co. of Australia, Ltd., for the introduction of a complete electric tramway system throughout the town and suburbs.

TELEGRAPH and TELEPHONE NOTES.

Post Office Telegraphs.—The annual report of the Postmaster-General for the year ended March 31st, 1907, shows that 89,493,000 telegrams were transmitted, practically identical with the previous year's traffic. Of these, 72,480,000 were ordinary, 5,912,000 Press, 9,147,000 foreign, and the remainder railway and Government telegrams, the receipts being for ordinary telegrams £2,231,312, Press £137,237, and foreign £418,026. During the year 227 new offices have been opened, making a total in the United Kingdom of 10,587 at Post Offices and 2,406 at railway stations, &c.

The underground lines are being extended to Edinburgh, and to the landing-places of the submarine cables in the West of England, where the pipes have been laid to Bristol, and the cables nearly to Bath; Leeds has been connected with the main London-Glasgow cable at Manchester. During the current year it is proposed to complete the Western line to Exeter, to provide a new cable between Liverpool and Warrington, to construct a line between Newcastle and Durham (eventually to join the main line *vid* Leeds), and to proceed with the Edinburgh extension.

The number of foreign telegrams during the year showed an increase of 4 per cent. Direct communication has been established between Liverpool and Antwerp.

Existing wireless telegraph licences have been extended, and 45 new applications have been received, of which 36 (for experimental use) have been granted. The rest have been held over, pending the consideration of the whole question of the use of wireless telegraphy in the United Kingdom for commercial communication with ships, which turns largely on the ratification of the International Convention. During the year 1,140 outward telegrams and 15,853 inward telegrams were transmitted to and from ships in connection with the Marconi Co.'s service, as compared with 558 and 11,094 respectively in 1905-6.

The number of telephone trunk wire centres open on March 31st was 533, compared with 487 in 1906. During the year 288 new trunk circuits were provided, making the total 2,043, containing about 73,000 miles of double wire. The capital expenditure increased by £478,749 to £3,376,252. The total number of conversations over the trunk wires was 19,803,300, an increase of 10 per cent., and the gross revenue was £480,658, an increase of 7·05 per cent., the average value per conversation being 5·82d. Besides 56 new Post Office exchanges in the provinces, 23 public call offices were opened at places where the traffic was insufficient to justify the opening of exchanges. In four districts the telegraph wires have been utilised to connect a town with adjoining villages by telephone. The use of the telephone in agricultural districts is increasing.

The total number of subscribers to the Post Office provincial exchanges (excluding Glasgow and Brighton) on March 31st was 10,010, compared with 8,425, and the number of telephones rented increased from 10,380 to 12,006. The Glasgow system included 11,103 subscribers' lines with 12,964 telephones, and the Brighton system 1,542 lines with 1,884 telephones. Arrangements are being made at these places for local intercommunication between P.O. and National subscribers.

The new scale of rates agreed upon with the National Telephone Co. is based entirely upon the measured rate system, except in the case of private residences, for which a flat rate is quoted. The reduced charges for trunk calls of three minutes' duration between 7 p.m. and 7 a.m. have led to increased traffic. The sum received as rental for private wires was £183,308 as compared with £177,111.

The municipal systems at Hull, Portsmouth and Swansea numbered at March 31st 2,128, 2,553 and 1,432 telephones respectively.

The number of telephones connected with the London Post Office system increased from 32,879 to 41,236, and five new exchanges were opened during the year. There were 425 P.O. call offices, and the number of calls from these increased by 42 per cent. The total length of pipes laid in the metropolitan area for telephone purposes was 2,030 miles, an increase of 349 miles; cables containing 317,789 miles of wire had been laid, including 69,066 miles rented by the National Telephone Co. and 52,255 miles for telegraphs and private wires. The lines in use amount to 111,516 miles, leaving 84,952 miles available for future development. About 65,000 miles of wire were laid during the year.

The average cost of constructing an exchange circuit in the metropolitan area has been £33 5s. 2d., compared with £35 13s. 10d. Including all spares, the capital expenditure per station now stands at less than £50, as against £54 and £64 in the two preceding years. The year's working of the whole telephone system shows a balance of £451,787, after payment of working expenses, while the allowance for depreciation and interest on capital is £432,726. The royalties paid by the National Telephone Co. amounted to £240,331, and by other licensees £3,101. The telephone is being increasingly used for forwarding messages for transmission as telegrams and letters, and for delivering telegrams.

The sum of £6,000,000 voted in the last session of Parliament for the extension of the telephone system is estimated to suffice until 1911.

Difficulties regarding wayleaves continue to cause embarrassment and delay in the execution of telephone and telegraph works.

An Awards Committee has been established to consider suggestions for improvements in machinery, &c., and to award payments from 5s. to £15; 342 suggestions were dealt with up to March 31st, and 111 awards were made.

The telegraph and telephone revenue of the year was £4,369,230, an increase of £217,850; and the expenditure was £5,021,285, an increase of £129,086. The net deficit on the telegraphs was £652,055, or £88,764 less than last year.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	..
Las Palmas-Arecife	Aug. 18, 1906 ..	..
Brest-Dakar	July 22, 1907 ..	..
Cotonou-Libreville	July 18, 1907 ..	Sept. 19.
LANDLINES.		
Puerto-Barrios	Aug. 2, 1903 ..	..

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ARGOED (MON.).—Mission Hall and Reading Room, for the Rev. R. W. Roberts. H. D. Blessley, architect, 22, Trinity Street, Cardiff.

ASHBY-DE-LA-ZOUCH (BREEDON-ON-THE-HILL).—New Vicarage (£1,189). Moss & Son, builders, Louthborough.

ASHTON-UNDER-LYNE.—Electric installation at the new Hospital for the Board of Guardians.

AYLESBURY.—Extensions to the Congregational schools (£1,839). Crook and Judd, builders, Waddesdon, Aylesbury.

BIRMINGHAM (SELLY OAK).—Extensions to Wesleyan Church and schools (£3,000). Rev. E. J. Brailsford, circuit superintendent.

BISHOP AUCKLAND.—Billiard Saloon for Popular Billiard Co., Ltd. F. H. Livesay, architect, 107, Newgate Street, Bishop Auckland.

BLACKWOOD (MON.).—New Council School at Rhiw-Syr-Dafydd. R. L. Roberts, architect, Abercarn.

BOLTON.—Temporary School (£700), to be followed by permanent school (£10,000). Bolton Education Committee.

Developments at Hulton Colliery Co.'s pits just initiated, Chequerbent. Write Mr. Brancker, managing director, Hulton Collieries, Chequerbent, Bolton.

BONNYRIGG (N.B.).—New Carnegie Library for the T.C.

BOURNEMOUTH (BOSCOMBE).—New Temperance Hall (£2,330). Lawson and Reynolds, architects, Yelverton Chambers, Bournemouth; W. Hayward & Son, builders, Bournemouth.

BRADFORD (LIDGET GREEN).—New Wesleyan Sunday schools. Abraham Sharp, architect, 16, Albany Buildings, Bradford.

BRAUNTON (near BARNSTAPLE).—Two semi-detached residences in Old Barnstaple Road. S. Edwards, architect, Cross Street, Barnstaple.

BRIDGEND (MAESTEG).—Shops and houses for E. Evans Bevan. J. Cook Rees, architect, Neath.

BRIGHTON.—Additions and alterations to Lewes Road Congregational Church (£1,200). Rev. F. J. Gould, Chairman of Committee.

BRIGHOUSE (SOUTHOWRAM).—Extension of brass and iron works. J. Blakeborough & Sons, Rastrick, Brighouse, owners.

BROADSTAIRS.—Bungalow at St. Mary's Home. Church Extension Association, owners.

BURSLEM.—Two shops for the Burslem Co-operative Society.

CARDIFF (LLANDAFF).—Parish Church to be enlarged (£2,096).

CARLISLE.—New St. Patrick's School in Albert Street. H. Foxall, architect, 54, Lowther Street, Carlisle.

CARLOW (IRELAND).—Fever Pavilion at Bagenalstown Hospital for Carlow Union. J. O'Donnell, engineer to the Board of Guardians, Carlow.

CHARD.—New schools to accommodate 600 for Somerset C.C. Cottam and Samson, architects, 43, High Street, Bridgwater.

CHESTERFIELD.—New shops for the Chesterfield Co-operative Society in Heywood Street, Brimington.

CHICHESTER.—Alterations to Bosham Council School. L. Thompson, secretary, West Sussex and Chichester Joint Education Committee, Horsham.

COVENTRY.—Hotel in Albany Road. Marston, Thompson & Co., owners.

Extensions to Midland Brewery. Phillips & Marriott, Ltd., Much Park Street, Coventry, owners.

CUPAR (FIFE).—Business extensions by Laird & Smith, seed merchants.

DUNDEE.—Workshop for Alex. Scott, Milnbank Road.

Improvements at Fish Market. Mr. High, Convener of Committee.

Villa for J. McLaren & Sons, Elgin Street.

Alterations to shop for F. J. Mackenzie, 22, St. Andrew's Street.

EASTBOURNE.—Extensions at Devonshire Park, including concert hall for 4,000 persons (£4,000 or £5,000). Devonshire Park Co., Ltd., owners.

ELLESMERE.—New Primitive Methodist Church (£1,600). Shayler & Ridge, architects; Wm. Griffiths & Sons, builders, Ellesmere.

ERITH.—Conversion of premises into General Post Office. J. T. Jarvis & Sons, builders, Erith.

FERNDALE (near PONTYPRIDD).—Swimming bath, hall and library for the Committee of the Workmen's Institute. T. E. Richards, architect, Market Square Chambers, Pontypridd.

GIFFNOCK (RENFREWSHIRE).—Double villa for G. Dixon & Sons, in Penrith Avenue.

GLOUCESTER.—Electric light to be installed at the Cathedral.

GOSFORTH (near NEWCASTLE).—First-class residential property on Graham Park Estate. J. R. & A. Morris, builders, Gosforth.

GRANTHAM.—Alterations to Fire Engine House and Weights and Measures Building for the T.C. Borough Surveyor, Grantham.

GREAT HARWOOD (LANCASHIRE).—New central premises for the Great Harwood Co-operative Society. F. J. Parkinson, architect, 9, Richmond Terrace, Blackburn.

GREENHITHE, SO. (KENT).—Factory for Wall Paper Manufacturers, Ltd. J. B. Lingham, builder.

HALTWHISTLE (NORTHUMBERLAND).—Church hall, class room, &c., in connection with Parish Church. J. M. Clark, surveyor, Haltwhistle.

HECKMONDWIKE.—Important additions to Walkley Mills. Blackburn, Tolson & Co., woollen manufacturers, Heckmondwike, owners.

HULL.—New club premises for St. Andrew's Club Co., Ltd. A. Easton, architect, 7, Land-of-Green-Ginger, Hull.

ILFORD.—Business premises in High Road. Stratford Co-operative Society, owners.

KETTERING.—Additions to factory. Kettering Boot and Shoe Manufacturing Co., owners.

LEICESTER.—New manse for Whetstone church.

LONDON (MAYFAIR, W.).—Extensive alterations, &c., to 17, Park Lane. Frank Bush, 8, Ridgmount Street, Gower Street, W., builder.

(BERMONDSEY).—Addition to St. Augustine's Church. R. L. Stuart and Sons, Rotherhithe, S.E., builders.

(BERMONDSEY).—Electricity to be installed by Noakes & Co., brewers, at their premises, 27, White's Grounds, S.E.

(FINCHLEY).—Enlargement of North Finchley Baptist Church; E.L. to be installed throughout. Mr. Whiting, architect, Bedford Row, W.C.

(CLAPHAM).—New Mission hall. W. Dewes, 4, Bloomsbury Place, W.C., architect.

(ST. JOHN'S WOOD ROAD, N.W.).—Motor garage. H. C. Clarke, 63, Bishopsgate Street Within, E.C., architect.

(BRIXTON HILL).—Buildings. Gush, Phillips, Walters and Williams, 3, Finsbury Circus, E.C.

(DULWICH).—Blocks of flats. Rutherford & Grierson, 4, Mitre Court Chambers, E.C., architects.

(PECKHAM).—Shops in Choumert Road. W. L. Doughton, 44, Theobald's Road, W.C., architect.

(PECKHAM.)—Buildings in Elm Grove. R. Saunders, 62, Bishopsgate Street Within, architect.

(HAMMERSMITH).—Building in Hammersmith Road. F. H. Jones, 8, Coleman Street, E.C.

(HAMPSTEAD).—Alterations to factory buildings. F. S. Hammond, 63, Fore Street, E.C., architect.

(ISLINGTON).—New theatre in Prah Road and St. Thomas' Road. F. Matcham & Co., 9, Warwick Court, High Holborn, W.C., architects.

(PORTUGAL STREET, STRAND).—Addition to St. Clement's Printing Works. Emden, Egan & Co., 2, Lancaster Place, W., architects.

(BETHNAL GREEN).—Additions to St. Andrew's Vicarage. T. J. Cook and Son, 65, Viaduct Street, E.C., builders.

(SOUTHWARK).—Building in St. George's Road. J. C. Radford, 189, Upper Richmond Road, Putney, architect.

(OLD KENT ROAD, S.E.).—Church hall in connection with All Saints' Church. J. E. P. & J. P. Cutts, 12, Southampton Street, W.C., architects.

(BERMONDSEY).—Building in Tidal Place. E. Crosse & Co., 1, Bermondsey Square, S.E., architects.

(WEST KENSINGTON).—Buildings. Messrs. Pallisers, 100A, North End Road, W., surveyors.

(FULHAM PALACE ROAD).—Congregational Church abutting on Harbord Street.

(FULHAM).—Dye works in High Street. W. J. Renshaw, 287, Upper Richmond Road, Putney, builder.

(FULHAM).—Six houses in Vera Road. A. Brickell, 61, Archel Road, West Kensington, W., builder.

(CITY).—Rebuilding drapery warehouse (1, Aldermanbury, and 71 and 73, Gresham Street) for Fownes Bros. & Co.

MANCHESTER.—Important extensions at Refuge Assurance Co.'s offices. Builders, W. Brown & Sons, Salford.

(WILMSLOW).—New Catholic Church to be built in Back Lane.

MANSFIELD (CRESWELL).—New Primitive Methodist Church in Station Road (£1,300) to be lit by electricity. Rev. J. Taws, Bolsover, Notts.

MARGATE.—Houses in Thanet Road. C. J. Reeve, architect, Grovenor Place, Margate.

MIDDLESBROUGH.—New shops in Crescent Road for the Middlesbrough Co-operative Society (£2,600).

(NORTH ORMESBY).—Abattoir, stabling, boiler-house, &c. S. E. Thorrold & Son, architects, North Ormesby.

MORRISTON (GLAM.).—New Baptist Sunday schools. Arnold, James & Co., builders, Morriston.

MOSLEY COMMON (TYLDESLEY, LANCS.).—Important extensions to Primitive Methodist Sunday School. Joseph Bridge, builder, Walkden, near Manchester.

MOUNTAIN ASH.—New Parish Church to be erected at Miskin (£4,000).

NELSON.—New cotton mill at Seedyford (2,000 looms). Holden Bros., Nelson, owners.

NEWLANDS (Renfrewshire).—Double villa in Laggan Road for Mrs. R. Walker, Bonavista, Newlands.

NOTTINGHAM.—New Primitive Methodist Church, Sherwood Rise. Hy. Harper, architect, 54, Long Row, Nottingham.

OLDHAM.—Important extensions at Fern Mill, Oldham.

PAISLEY.—Dyeing and finishing works at Glenfield for W. Fulton & Son Ltd., of Paisley.

PERTH.—New Technical school proposed by Lord Provost.

PONTYPOOL (Blaenavon).—Villa residence for T. Ruther, New William Street, Blaenavon (Mon.).

PORT TALBOT.—New Wesleyan Mission Hall (£4,000).

PURDYSBURN (Belfast).—Infectious diseases hospital to be enlarged (£10,000).

QUEENBOROUGH (Rushenden).—Waterworks for the T.C. to be electrically equipped.

RICHMOND-ON-THAMES.—Shops in George Street. J. C. Radford, Richmond, Surrey.

ROCHDALE.—New mill for the Crown Doubling Co., Ltd.

ROTHERHAM.—Block of business premises corner of Westgate. J. Platts, architect, High Street, Rotherham.

SCARBOROUGH.—Remodelling Hippodrome in Thomas Street. W. Peacock, manager, Opera House, York.

SHOEBURYNESS.—Council Chamber, offices and fire station for the U.D.C. Burles & Harris, architects, Clarence Chambers, Southend-on-Sea.

SINCLAIRSTOWN (N.B.).—New passenger and goods stations for the North British Railway Co.

STOCKPORT.—New Roman Catholic Schools at Edgeley.

SUNDERLAND.—Extensions at the Municipal Technical College, including new engineering laboratories and day training college, for the T.C. (£10,000).

SWANSEA.—New hosiery mills electrically equipped. D. E. Williams & Co., Park Mills, Llandilo, owners.

SYKEHOUSE.—New elementary school for the C.C.

WHITBY.—Residence at Sleights for Mrs. Wood. J. Braim, builder, Whitby.

WOKING (Pyrford).—New Home for Crippled Children, for the Church of England Waifs and Strays Society. Musselwhite & Sapp, builders.

WOLSTANTON (Staffs.).—Extensions to Ellison Street Schools. W. F. Slater, architect, Overhouse Chambers, Burslem.

WOLVERHAMPTON.—New church in Hilton Street, Springfields (£6,000).

WORKSOP.—New Post Office to be erected by Office of Works.

YEOVIL.—Houses in Middle Street and the Grove. Bird & Pippard, builders, Middle Street, Yeovil.

CONTRACTS OPEN and CLOSED.

OPEN.

Antwerp.—October 17th. The municipal authorities are calling for tenders for the installation of electric light in the Salle de Fêtes recently erected in the Place de Meir, Antwerp. A deposit of 8,000 francs (about £320) will be required to qualify any tender. Specification from the Hotel de Ville, Antwerp, at a cost of 0·50 franc. A copy may be inspected by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Austria.—October 15th. The Municipal Authorities of Schoenberg, in Mähren, require tenders by October 15th for the erection, equipment, &c., of a central power station. Details may be obtained from the Buergermeisteramt (Abtheilung Bauamt), of Nähr-Schönberg.

Australia.—New South Wales.—October 23rd. Galvanised iron wire, 1,600 insulators and 500 wall telephones, for the G.P.O., Sydney. Specifications, &c., may be seen at the Electrical Review offices.

New South Wales.—October 30th. The Postmaster-General at Sydney requires tenders for 21,000 best white porcelain insulators; 55½ tons hard drawn copper wire, 300 lb. per mile; 15 cwt. copper binding tape, 300 lb. per mile; 62 tons galvanised iron wire, 500 lb. per mile.

New South Wales.—November 6th. Postmaster-General's department. Tenders are required by November 6th as follows:—14½ tons hard-drawn copper wire (300 lb. per mile); 4 cwt. copper binding tape (200 lb. per mile, $\frac{3}{8}$ in. wide); 3,500 large insulators (best white porcelain); 1,000 tallow wood cross-arms, 3 ft. 10 in., complete; 2,500 ditto, 5 ft. 2 in.

New South Wales.—December 11th. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, for the supply and delivery, at the Central Exchange, General Post Office, Sydney, of the following: 1,000 telephones, wall, common battery; 100 telephones, table, common battery. Specifications may be seen at the office of the Electrical Review.

South Australia.—January 8th, 1908. One common battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria Street, S.W.

Victoria.—January 7th, 1908. The Postmaster-General requires tenders for 11 sections of a common-battery switchboard and 3,000 subscribers' telephones and other apparatus, for the telephone exchange at Windsor.

Belgium.—September 28th. La Société du Canal et des Installations Maritimes de Bruxelles, of 59, Rue du Canal, Brussels, is inviting tenders for an installation of an electric lighting plant in the basement of the principal building. Particulars may be obtained from the above address for 5s. 6d.

Belgium.—(No date fixed.) The Belgian State Railways, 11, Rue de Louvain, Brussels, will shortly call for tenders for annual supplies of materials and appliances for lighting trains by electricity.

They also require for Tournai Railway station supplies as follows: (1) 36 iron standards; (2) two switchboards; (3) fittings; (4) insulators; (5) bronze wire, &c.; (6) insulated cable and wire; (7) galvanised iron wire, 7 mm. in diameter, hoisting cable, &c.

Clacton.—October 2nd. Vulcanised bitumen distributing mains and service cables. See "Official Notices" to-day.

Cologne.—October 9th. The Telegraph Construction Branch of the Prussian Railways requires 40,000 tons copper bronze wire. Particulars may be obtained up to September 25th, for 6s. each, at the Hansvernaltung of the k. Eisenbahn direction, Dornhof 28.

Dublin.—September 30th. 500 A.C. single-phase, and 100 A.C. three-phase meters for the Corporation Lighting Committee. See "Official Notices" September 13th.

Dundee.—The Electricity Committee invites tenders for meters. H. Richardson, Corporation engineer. The Corporation is also inviting tenders for 110 overcoats for tram conductors and drivers. Applications to P. Fisher, manager.

East Indian Railway.—October 2nd. Supply and delivery of one 600-KW. generator for the East Indian Railway Co. See "Official Notices" September 13th.

Egypt.—November 1st. The Alexandria Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Postes et Phares.

Germany.—The municipal authorities of Landsbeck, Silesia, are about to invite tenders for the extension of the central electric lighting station, at an estimated cost of £5,250.

Italy.—November 4th. The municipal authorities of Acireale, in the province of Catania, require offers for the installation and working of an electric lighting and power installation, for 30 years. The city will contribute £1,480 per year for 112,278·40 KW.-hours, and the company must deliver any further current required for lighting at 3½d. per KW.-hour. A deposit of £160 is required. Tenders are to be made to the Sindreo, and the amounts and names are to be considered strictly confidential.

L.C.C.—October 8th. Three electrically-driven boiler feed pumps (each 9,000 gallons per hour capacity) for the East Greenwich tramway generating station. See "Official Notices" August 30th.

Mersey Railway Co.—The directors are inviting tenders for stores, including electrical sundries, incandescent lamps and fittings, signal gear and wire, &c. Forms of tender from G. H. Langham, secretary, Worcester House, Walbrook, E.C.

Norwich.—September 23rd. Incandescent lamps for 12 months for the Corporation. See "Official Notices" September 13th.

Paris.—October 24th. The Municipal Waterworks Department (Service des eaux, canaux et égouts) requires tenders for the supply and erection at the Austerlitz works of (1) four sets of motor-driven pumps, dynamos, &c., complete, capable of lifting 100,000 cubic metres of water per day into either of two reservoirs, or 50,000 cubic metres into both at the same time; (2) and one reserve set; (3) 10 boilers in two groups of three, and one of four. Particulars may be obtained at the Hotel de Ville.

Paris.—September 25th and December 20th. The Government Printer requires tenders for supply of eight electric lifts. Application to be included in list of tenderers must be made to the Directeur de l'Imprimerie Nationale, 87, Rue Vicille-du-Temple, Paris, by the 25th inst. Tenders will be due by December 20th.

Peterborough.—October 3rd. Feeder cables for the Corporation. See "Official Notices" to-day.

Portrush.—November 2nd. The U.D.C. invites tenders for a thorough and complete lighting installation by means of either electricity or gas. Specifications prepared by Mr. John Woodside, A.M.I.E.E., Ocean Buildings, Belfast. Copies can be seen at the office of Council, Town Hall, Portrush.

Southampton.—The Corporation requires sundry underground cables, conduits, and earthenware troughs. See "Official Notices" August 23rd.

Southampton.—Second-hand steam generator of about 200 KW., at 420-440 V., D.C., on loan, for the Corporation. See "Official Notices" to-day.

Spain.—September 28th. The municipal authorities of Chirivella (province of Valencia) are inviting tenders for the concession for the electric lighting of the town during a period of ten years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Chirivella (Valencia).

Spain.—(No date fixed.) The Minister for Posts and Telegraphs requires tenders for the repairing of telegraph lines as follows:—

20	tons	galvanised	iron	wire	5 mm. diameter
20	„	„	„	4	„ „
4	„	bronze	„	2	„ „

Applications are to be made to Direccion General de Telegrafos y Correos, 10, Carretas, Madrid.

Sweden.—October 1st. The General Direction of the Canal and Waterworks at Trolhattan, Sweden, are inviting tenders for three 350-KW. continuous-current dynamos, a 4,800-ampere-hour battery of accumulators, four three-phase alternators of 11,000-kilovolt-ampere capacity, 12 relays, regulators, switchboards, &c.

Swinton and Pendlebury.—September 28th. Wiring, on the hire-purchase system, of buildings for electric light, for the U.D.C. See "Official Notices" September 13th.

West Ham.—October 3rd. India-rubber-covered wires and cables for six months for the Corporation. See "Official Notices" to-day.

Willesden.—September 28th. Seven 50-KW. static transformers for the U.D.C. See "Official Notices" to-day.

CLOSED.

Brighton.—The Corporation Lighting Committee recommends the acceptance of the tender of Messrs. W. Cory & Son, Ltd., for the supply to the Southwick Power Station, during the six months commencing October 1st next, of not less than 13,000 or more than 15,000 tons of Hillhouse washed nuts at 16s. 11d. per ton.

Brush Contracts.—The Brush Electrical Engineering Co., Ltd., has booked the following contracts:—

For the Bombay Electric Supply and Tramways Co.—50 single type trucks; 25 car bodies; 50 sets motor equipment.

For St. Albans (North Met. Elec. Power Supply Co.)—two 150-KW. steam dynamos and accessories.

Clonmel Asylum.—The E.L. Committee of the Management of this Asylum received 33 tenders for Section 1 (gas engines, suction gas plant, and electric generators) and Section 2 (accumulators, underground mains, wirings and fittings). They recommended the acceptance of the tender of the Alliance Electric Co., Dublin, for Section 1, at £1,250, and for Section 2, Messrs. Dargue and Griffiths, Liverpool, at £1,476. There was no tender for Section 3 (power-house), and it was decided that this be re-advertised. The Committee has unanimously declined to pay the sum of £19 19s. called for by the L.G.B. as the expense of holding the recent inquiry in regard to the electric lighting scheme, as it was not considered necessary or called for by the Committee.

Heston and Isleworth.—On Tuesday the D.C. accepted the following tenders:—

Messrs. Chamberlain & Hookham, electricity meters (general sizes)—

25-ampere	(240 volts)	.. .. ..	£2 10s. each
50 „	„	.. .. ..	2 14s. „
100 „	„	.. .. ..	3 3s. „
25 „	(480 volts)	.. .. ..	2 10s. „
50 „	„	.. .. ..	2 14s. „
100 „	„	.. .. ..	3 3s. „
200 „	„	.. .. ..	8 „

Messrs. Siemens Bros. electricity meters (special sizes)—

5-ampere meters	(240 volts)	..	£1 15s.	each
5 „ „	(480 „)	..	1 15s.	„
10 „ „	(240 „)	..	1 17s. 6d.	„
10 „ „	(480 „)	..	1 17s. 6d.	„

Messrs. Mordey-Fricker, prepayment electricity meters—

3-ampere meters	..	£2 5s.	each
5 „ „	..	2 5s.	„

Johnson & Phillips's Contracts.—The following contracts have been booked by the above firm:—

GRIMSBY.—For the Electricity Committee, supply of cables for the next two years.

DERBY.—For the Electricity Department, supply of Paterson's vulcanised bitumen cable.

LOCH LEVEN.—For the directors of the Loch Leven Water and Electric Power Co., supply and erection of overhead transmission lines, including telephones, lighting and traction, with aluminium cables.

KEIGHLEY.—For the Corporation, supply of Paterson's vulcanised bitumen cable.

London.—The Metropolitan Asylums Board received the following tenders for alterations to the fire alarms and telephones at the Gore Farm Upper and Lower Hospitals:—

Electrical Engineering & Maintenance Co.,	(accepted)	£173
Private Wire and Telephone Installation Co., Ltd.	„	226
J. Bryden & Sons		248 10s.
H. J. Galliers		257
National Telephone Co., Ltd.		275
Speedy, Eynon & Co.		295
T. Potter & Sons		299
J. W. Gray & Son		300
W. G. Cannon & Sons, Ltd.		375
Watford Engineering Works		400

The engineer-in-chief's estimate was £180.

HAMMERSMITH.—On July 24th the B.C. accepted the tender of the Main Colliery Co., Ltd., to supply Main Through coal to the generating station at 18s. 3d. per ton for a period of three months. At that time the company offered to keep their quotation open for two months to enable the Council if it thought desirable to arrange for a supply at the same rate for a further period of six months. The engineer having reported that there appeared to be no prospect of the price of coal dropping in the immediate future, the Electricity Committee did not think it advisable to risk paying an increased price at the end of October. As the company's offer closed on the 16th inst., the Committee accordingly gave instructions for the acceptance of the offer for the supply for a further six months at the price quoted.

STEPNEY.—The contract for the electric lighting of Dr. Barnardo's Home has been secured by Messrs. Strange & Sons, Ltd., of London Road, Tonbridge, and Tunbridge Wells. We are informed that four firms tendered.

Lowestoft.—The T.C. has accepted the tender of Messrs. Mann, Egerton & Co., Ltd., of Ipswich, for free wiring.

Portslade.—The U.D.C. has accepted the tender of the General Post Office for the installation of firemen's bells at £20 12s. 6d. per annum for ten years.

Shipley.—Mr. Chas. Pullan, of Bradford, has secured the contract for the electric lighting of the Queen's Palace Theatre. The whole of the wiring is to be carried out in a screwed conduit system, and the supply will be taken from the U.D.C. mains.

Sydney (N.S.W.).—According to the *Australian Hardware and Machinery*, the Clyde Engineering Co., Ltd., of Granville, Sydney, have secured a contract for 60 tramway trucks for the New South Wales Government. These are the portions of the tramcars which have hitherto been imported. Before the order was placed certain firms were supplied with plans of the trucks now in use and were asked to quote, with the foregoing result.

Worksop.—The U.D.C. has accepted the tender of Messrs. W. T. Glover & Co. for the supply of cables and joint boxes, at £1,391.

FORTHCOMING EVENTS.

Wednesday, September 25th, to September 27th.—Municipal Tramways Association. Annual Conference, at Manchester.

Thursday, September 26th.—At 3.30 p.m. Junior Institution of Engineers. Visit to Engineering and Machinery Exhibition at Olympia.

Thursday, October 3rd.—At 8 p.m. At Caxton Hall, Westminster, Civil and Mechanical Engineers' Society: Presidential address by Mr. W. N. Twelvetrees.

Engineering and Machinery Exhibition at Olympia. Open until October 19th.

Effect of Fly-wheel in Planing-Machine Drive.—A planing machine requires at the instant of reversal several times the average power taken throughout a complete cycle. This power may amount to as much as five to six times that required during the cutting period. Such a drive is, of course, very severe on a motor unless a fly-wheel is provided to level up the power curve. Not only can the peaks be smoothed out, but the consumption of energy may also be reduced by the use of a fly-wheel. A record of some tests made on a 36 in. × 36 in. × 10 ft. planer, with the object of determining the effect of changing the length of stroke and of fly-wheeling, is given by Mr. H. P. Fairfield in a recent issue of the *Journal* of the Worcester Polytechnic Institute. The fly-wheel was fitted directly on the spindle of the motor, which was of the induction type, and was designed to store and re-store energy to take care of the reversal without material change in the speed of the motor. The work put on a planer of this size will be such that the machine will be worked at from half to full stroke, and tests were made, therefore, with a 5-ft. stroke, using the full width of the planer, and a 10-ft. stroke using half the width of the planer. The surface covered therefore was the same in both cases. The number of reversals with the 5-ft. stroke was double that with the 10-ft. stroke. The results were as follows:—

5-ft.	stroke	without	fly-wheel —	1·848 units consumed.
10	„		„	1·626 „
5	„	with	„	1·302 „
10	„	„	„	1·240 „

The Engineering Exhibition at Olympia.—This second Engineering and Machinery Exhibition at Olympia was opened yesterday by Sir Alexander Kennedy. We shall refer to the exhibits that are of electrical and allied interest in later issues.

NOTES.

Municipal Electricity Supply to Cotton Mills.—Messrs. Willans & Robinson, Ltd., have recently set to work two 2,000-kw. turbines in the generating station of the Stalybridge, Hyde, Mossley and Dukinfield Tramways Board, whose chief engineer is Mr. Robert Blackmore. Each turbine is rated for a normal load of 2,000 kw., but is capable of giving an overload of 20 per cent. when running at a speed of 1,200 r.p.m., which the periodicity adopted, namely, 40, necessitates. The steam pressure is 175 lb., superheated to 150° F., and the turbines exhaust into a vacuum of 27 in., which the surface condensers are capable of maintaining when fed with water at a temperature of 85° F. The condensers have been built by Messrs. Willans & Robinson, Ltd., the air pumps being three-throw and of the Edwards type. The air-pump is driven by a 19-b.h.p. three-phase motor through single-reduction gearing; the circulating pumps are of the Gwynne type, capable of delivering about 4,500 gal. per minute against a head of approximately 30 ft., and are driven by a 70-b.h.p. three-phase motor. The alternators are of the three-phase type and were built by Messrs. Bruce Peebles; they are arranged for working at a pressure of 6,000 volts, 40 cycles per second, and for giving the normal load with a power factor of ·85. Each of the alternators has directly coupled on its shaft a 100-volt exciter. The Stalybridge Board has succeeded in creating a big business in the direction of power supply to industrial works, and the load which this station has now to deal with in the direction of supply to mills is a heavy one.

Technical Training Appreciated.—According to the *Electrical World*, the General Electric Co. has taken on at its Schenectady works 248 of this year's graduates from electrical engineering courses.

Fires.—The *Financial Times* says that on Monday morning a L. & N.W. goods train, consisting of 11 wagons laden with telephone poles, became ignited by sparks from the engine on the way from Crewe. It was stopped at Marsden, near Huddersfield, but, in spite of the efforts of the Huddersfield fire brigade, the whole of the trucks and contents were destroyed.

A fire broke out at the rear of the works of the General Electric Co., Ltd., in Union Street, S.E., on Tuesday last, in some railway arches used for storage purposes. No damage was done to the works, and the stores destroyed were of no great importance.

Picketing.—The *Times* reports that the first local case as to picketing since the Trade Disputes Act was passed was heard by the Leeds Stipendiary Magistrate on the 13th inst., when charges of intimidation and assault were preferred. There was a strike at the brass foundry of Messrs. S. Dixon & Son, in which the three defendants were concerned. It was shown that there was a great crowd of people at the gates of the works, and that picketing was practised. Mr. Clifford Bowling, for the prosecution, said that although the facts might not disclose brutality and the horrible scenes sometimes associated with strikes, there were facts which showed that the employés should be protected. The defendants were bound over to appear on Tuesday and find sureties.

Anchor Upsets Sydney Tramway Service.—A correspondent, writing from Sydney (N.S.W.), under date August 13th, 1907, says:—"One does not usually expect to have to take into consideration any questions of wind pressure when dealing with the laying of underground or submarine cables, but the effect of a squall of wind on Thursday last resulted in such a disturbance to the submarine cables supplying the North Shore sections of the Sydney tramway as to cause a serious derangement. The circumstances were, perhaps, somewhat unusual, and were not such as will necessitate the interpolation of any new rules or formulæ for cable laying in the pocket-books. It happened that the wind was very squally, with gusts up to 50 miles an hour or more, and while one of the Union Steamship Co.'s steamers was passing up the harbour at the regulation slow speed, one of these sudden squalls caught her just as she was passing through the narrowest part of the harbour, between Milson's and Dawes Points. An anchor was dropped to act as a drag, and was dropped just at the right spot and at the right time to catch hold of the high-tension feeders which cross the harbour just at this spot. The anchor not only got firm hold and broke the cables at the Milson's Point shore end, but retained hold and carried them right up the harbour. Unfortunately, a want of intelligence was shown by the ship's officers when, on hauling the anchor apeak, the cables were found attached to it, as the cables were simply detached and cast overboard, instead of being buoyed. The service was maintained to a great extent by the aid of the low-tension feeders, which, fortunately, escaped injury, and the batteries at the sub-stations."

Cricket Match.—A match was played on Saturday last at Edgware between the staff of the Head Office M.E.T. and the men of the Willesden Power House. H.O. batted first and made a score of 86, leaving Willesden 25 minutes to bat. They scored 76, in 22 minutes, for three wickets, when their opponents left the field on the plea of catching a train. The game thus ended in a draw.

Appointments Vacant.—Assistant electrical engineer for Harness and Saddlery Factory of the Indian Ordnance Department, Cawnpore (280 Rs. monthly); switchboard attendant for Eccles electricity works (24s.).

Municipal Tramways Association.—The sixth annua Conference will be held in the Town Hall, Manchester, on Septem ber 25th, 26th and 27th. The proceedings will be as follows:—

Wednesday, September 25th.

Presidential address by Mr. J. M. McElroy, general manager, Manchester Corporation Tramways.

A paper on "Long wheel-base trucks"; by Mr. R. L. Acland, general manager, Chesterfield Corporation Tramways.

A paper on "Employés' hours of labour, rates of pay and methods of computing same"; by Mr. A. Baker, general manager, Birmingham Corporation Tramways. Followed by luncheon at the Town Hall, Manchester; visits to Hyde Road Car Works and Stuart Street generating station, and a reception at the Town Hall in the evening.

Thursday, September 26th.

Business meeting of the Association.

Paper on "Staff Organisation"; by Mr. J. Dalrymple, general manager, Glasgow Corporation Tramways. Followed by luncheon at the Town Hall, Salford, and a visit to Buile Hill Park and dinner at the "White City," Old Trafford.

Friday, September 27th.

A paper on "Rail Corrugations"; by Mr. A. L. C. Fell, chief officer, L.C.C. Tramways.

The afternoon will be devoted to an excursion to Tatton Park, Knutsford.

Theft.—The manner in which several thefts were committed at the Bolton Electricity Works was cleared up on Wednesday, 11th inst. Twice in June and twice again in August the works were entered, and a number of fittings removed, as well as lead. The place was entered by means of an aperture created through the removal of a board. Two prisoners were before the magistrates at Bolton on Wednesday—George Davies, a cripple, and Daniel, his son, aged 14. It appeared that the actual theft was committed by the lad, and the prosecuting solicitor said the man was a criminal, and the best thing that could happen to the son was to remove him from his father's influence. The father was sentenced to nine months' imprisonment, and an order was made for the lad to be detained in a reformatory for four years.

Fatalities.—A youth, 15 years of age, named Edwards, was killed at the Littleton Collieries, Huntington, near Cannock, last week. It appears that he was employed as driver of an electric motor in the mine, and it is supposed that in some way or another he came in contact with a live wire, from which he received a shock at 500 volts. His father was given the signal to draw the cage to the surface, "as one of those motor chaps had got hurt."

According to the daily Press, a car conductor named Prudence, in the employ of the London United Tramways, Ltd., was killed on Saturday. It seems that on leaving the Fulwell Tramway Depôt for Hammersmith he was engaged on the top of the car in transferring the trolley-arm to the up overhead electric wire when he fell to the road, death being instantaneous.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Officials.—Mr. F. W. E. Jones, manager and engineer to the Midland Electric Light and Power Co., of Leamington, is retiring after 15 years' service. The employés of the company have presented him with a silver cigar case.

Shoreditch Borough Council on Tuesday appointed Mr. W. Weeks to be assistant electrical engineer, at a salary of £175 per annum, to be raised in four months to £200 per annum, and increasing annually to £250. Mr. Weeks has been for eight years in the service of the department as electrician-in-charge, and has for the past two months satisfactorily carried out the duties of assistant engineer.

The question of an increase to the salary of Mr. D. F. Francis, tramway and electrical engineer, at Kirkcaldy, has been postponed, although the Committee agreed that an advance of £50 be granted. At the Council meeting it was moved that no increase be granted, a member pointing out that the management of the tramways and electrical departments cost £900 per annum with a turnover of £22,000.

The Review of the River Plate welcomes back to Buenos Ayres Mr. John H. Bouwer, who, for the past eight months, has been acting as manager of the Concordia station of the Anglo-Argentine Electric Light Co., and who has now been appointed general superintendent of all the company's stations.

The Walsall Electricity Committee has passed a resolution expressing regret at the resignation of Mr. Alexander Wyllie, electrical engineer, on his being appointed to a similar position at Auckland, New Zealand, and has placed on record its high appreciation of the able and zealous manner in which he has discharged the duties of his office during the 12 years he has held the appointment at Walsall.

Australian Hardware and Machinery says that in connection with the scheme of the Perth (W.A.) City Council to install a system of

electric lighting, Mr. H. Edmiston, a local man, has been chosen city electrical engineer out of 29 applicants.

On Friday afternoon last, Mr. Alfred Mercer, mains superintendent to the Gravesend electricity department, was the recipient of a silver tea service, on the occasion of his wedding, which took place at Sidcup on the following day. The presentation was made by the borough electrical engineer, Mr. C. F. McInnes, on behalf of the staff and employés of the works and public lighting department.

Tramway Officials.—Mr. J. W. Blakemore, chief traffic clerk to the Salford electric tramways, has, on the occasion of his marriage, been presented with an oak clock, from the general manager and his staff; a pair of bronzes from the motormen and conductors on the Swinton section; a flower stand from the ticket inspectors; and a pair of vases from the Deansgate timekeepers. The presentions were made by Mr. G. W. Holford, the general manager.

General.—Mr. W. L. Hogg, chief assistant to Mr. F. G. Smith, head of the generator department at the Rugby works of the British Thomson-Houston Co., who is leaving for Canada, has been presented by the company's staff with a cabin trunk, a pair of binoculars, a gold fountain pen, Kent's handbook, a silver matchbox, and a framed illuminated address.

Mr. Charles Reid has been appointed technical laboratory assistant to the British Westinghouse Electrical Manufacturing Co., Trafford Park, Manchester. He was previously in the company's service at Motherwell.

The Review of the River Plate says that Mr. E. W. Dean, who was chief engineer to the Primitiva Electric Light Co., has been appointed electrical engineer to the Rosario Railway, to erect and run the power plant to be put up in their workshops at Rosario.

At Cardiff last week, Mr. S. B. Haslam, A.M.I.E.E., of Messrs. Haslam & Schontheil, engineers, Cardiff, was married to Miss E. M. Riches, youngest daughter of Mr. T. Hurry Riches, locomotive superintendent of the Taff Vale Railway, and President of the Institution of Mechanical Engineers.

On September 3rd, at the Congregational Church, Deal, the marriage was solemnised of Walter Talboys, only son of the late W. W. Wheeler, of Bank House, Cowes, I.W., to Elizabeth Nellie, second daughter of Bowes M. Beer, of Heath Villa, Cowper Road, Deal.

Mr. A. E. Uttley, Government Electrical Engineer of Rhodesia, who for the last few months has been on a visit to the Old Country, was married on Wednesday, September 11th, to Miss Gertrude M. Lunn, of Lea, Lincolnshire. Mr. and Mrs. Uttley sailed for South Africa on Saturday last, September 14th.

At the request of the Indian Government, Mr. J. Newlands, deputy-controller at the chief telegraph office, St. Martin's-le-Grand, is about to leave for India to reorganise the telegraph system of that country.

Mr. R. W. Perry, late engineer-in-charge of the Wandsworth generating station of the County of London Electric Supply Co., Ltd., and also late general manager of the Conduit and Insulation Co., of Summers Town, has been appointed manager of the Perfecta Seamless Steel Tube and Conduit Co., Ltd., of Plume Street, Birmingham.

Electrical engineers, and all scientists, will learn with deep regret of the serious illness of Lady Kelvin. It was reported on Wednesday evening that her condition showed some improvement. Our readers will, we are sure, join with us in hoping that the improvement may be maintained, and that her ladyship may long be spared as a helpmeet to her celebrated husband.

NEW COMPANIES REGISTERED.

General Acoustic (London) Syndicate, Ltd. (94,797).—This company was registered on September 3rd, with a capital of 10,000 in £1 shares, to enter into an assignment between H. Mather and the company, for the option over certain patents and patent rights therein mentioned in connection with an invention known as the "Dictograph," and to carry on the business of manufacturers of, and dealers in, "Dictographs," and other instruments used for telephonic and similar purposes, electrical and mechanical engineers, &c. The first subscribers (each with one share) are:—J. E. Gillham, 3-4, Great Winchester Street, E.C., chartered accountant; J. Spittle, 20, Rembrandt Road, Lee, engineer; E. A. Brett, 2, Copthall Buildings, E.C., stockbroker; F. K. Gillham, 3, Hillfield Park, Muswell Hill, N., traveller; C. R. Pease, Brook House, Walbrook, E.C., mining broker; G. Beeson, 1, Roswell Road, W., clerk; and E. Sorrell, 152, Hainault Road, Leytonstone, clerk. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification (except first directors), £250; remuneration as fixed by the company. Registered office, 3 and 4, Great Winchester Street, E.C.

Langdon-Davies Motors (Canada), Ltd. (94,889).—This company was registered on September 12th, with a capital of £1,000 in £1 shares, to carry on the business of producers of and dealers in electric and other motors, gas, oil, petrol and other engines, motor-cars, dynamos, apparatus, accessories and fittings, &c. The first subscribers (each with one share) are:—A. E. Alston, Manningtree, Essex, brewer; F. B. O. Hawes, 12, Park Mansions, Vauxhall Park, S.W., civil engineer; D. M. A. G. Hawes, 75, Queen Victoria Street, E.C., mechanical engineer; E. G. A. Chambers, 13, Palliser Court, W., electrical engineer; V. Smith, 48, Baron's Court Road, West Kensington, W., electrical engineer; W. R. Sidwell, 35, Fernbrook Road, Lee, S.E., secretary; and T. G. Spyers, 3, New Court, Lincoln's Inn, W.C., barrister. No initial public issue. The first directors are F. B. O. Hawes and A. E. Alston; qualification, £50; remuneration as fixed by the company. The Langdon-Davies Motor Co., Ltd., of Southwark, S.E., have consented to this registration.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Cascade (1906) Power Co., Ltd.—A memorandum of satisfaction to the extent of £4,465 of 4 per cent. debenture stock dated September 21st, 1906, securing £75,000, has been filed.

Suffolk Electricity Supply Co., Ltd. (58,665).—This company's annual return was filed on July 12th, when 877 ordinary, and 200 founders' shares had been taken up out of a nominal capital of £10,000 in 980 ordinary shares of £10 each, and 200 founders' shares of £1 each. £10 per share has been called up on 628 ordinary, and £1 per share on 17 founders' shares, resulting in the receipt of £6,297. £2,673 is considered as paid on 249 ordinary, and 183 founders. Mortgages and charges: £3,875.

Potteries Electric Traction Co., Ltd. (57,968).—This company's annual return was filed on July 2nd, when 245,000 preference, and 245,000 ordinary shares, had been taken up out of a nominal capital of £600,000 in 300,000 ordinary, and 300,000 preference shares of £1. £1 per share has been called up on 178,340 ordinary, and 245,000 preference, resulting in the receipt of £423,340. £66,660 is considered as paid on 66,660 ordinary. Mortgages and charges: £245,000.

Buenos Ayres Electric Light Co., Ltd. (16,057).—This company's annual return was filed on August 20th, when 70 founders' shares had been taken up out of a nominal capital of £100,000 in 9,986 shares of £10 each, and 70 founders' shares of £2 each. No calls have been made. Mortgages and charges: Nil.

A. Hirst & Son, Ltd. (57,889).—This company's annual return was filed on July 5th, when 100 preference and 310 ordinary shares had been taken up out of a nominal capital of £5,000 in £10 shares (100 preference and 400 ordinary). £1,000 has been paid on 100 preference and 10 ordinary, and £3,000 is considered as paid on 300 ordinary shares. Mortgages and charges: £2,000.

Variable Electric Lamp Syndicate, Ltd. (92,495).—The statutory report, dated July 30th (filed August 1st) shows 957 shares taken up, subject to payment in cash, out of a nominal capital of £7,500 in £1 shares. £367 10s. had been paid up to the date of the report. No mortgages or charges registered.

National Electric Construction Co., Ltd. (53,364).—Particulars of £75,000 debentures created by resolution of May 6th and secured by a trust deed dated May 7th, 1907 (already registered) have been filed, pursuant to Section 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: L. B. Schlesinger, 21, Cornhill, E.C., and R. Williams, Norfolk House, Victoria Embankment, W.C.

Cleveland and Durham Electric Power, Ltd.—A deed of indemnity and security, dated August 10th, 1907, covering any moneys payable under a bond of suretyship for £5,000 for performance of contract, given to the Mayor, Aldermen and Burgesses of Middlesbrough by Sir Hugh Bell, Bart., of Rounton Grange, Yorks, and Sir John D. Milburn, Bart., of Guyzance, near Acklington, Northumberland, has been registered. Property charged: The company's assets, present and future, except uncalled capital.

Anglo-Portuguese Telephone Co., Ltd. (24,545).—This company's annual return was filed on August 12th, when the entire capital of £100,000 in £1 shares had been taken up. £1,046 has been paid, and £98,954 is considered as paid. Mortgages and charges: £48,900.

J. G. White & Co., Ltd. (66,568).—This company's annual return was filed on July 13th, when the entire capital of £200,000 in 15,000 preference shares of £10 each and 50,000 ordinary shares of £1 each had been taken up. £150,000 has been paid on the preference and £50,000 is considered as paid on the ordinary. Mortgages and charges: Nil.

CITY NOTES.

Dick, Kerr & Co., Ltd.

The directors' report states that the profits earned during the 12 months' trading to June 30th, 1907, amount to £80,476. Out of this has had to be paid debenture interest and trustees' fees, and there has been reserved the sum required to provide for the premium payable on the redemption of the present debenture stock. These items absorb £13,112, leaving a balance of £67,363, to which must be added the profits brought forward from last year, viz., £56,077, making a total of £123,440 available for appropriation as under:—Dividend of 6 per cent. per annum on the preference share capital, £18,300 (the proportion of this dividend to December 31st, 1906, has already been paid); dividend of 10 per cent. on the ordinary share capital of £260,000, free of income-tax, £26,000; carrying forward, £79,140. The dividend on the preference shares will be paid on October 1st, 1907, as usual, and the dividend recommended on the ordinary shares will be paid when approved by the shareholders. The directors consider the result of the 12 months' trading very satisfactory, in view of the severe competition which has prevailed, the greatly increased cost of all raw materials, and the advance in cost of labour. The directors do not consider it necessary to make any further additions to reserves at the present time, and have therefore increased the amount carried forward by the balance of this year's profits, £23,063 8s. 1d., making the total profits carried forward to next year, £79,140. Two directors retire, Mr. D. C. Ellis and Mr. G. Richardson, and, being eligible, offer themselves for re-election. [Last year the dividend was at the same rate, £15,000 was carried to special reserve, and £56,067 was carried forward.]

Kalgoorlie Electric Power and Lighting Corporation, Ltd.—The directors have declared a dividend on the preference shares at the rate of 6 per cent. per annum for the six months ending September 30th.

Globe Telegraph and Trust Co., Ltd.—The directors announce a quarterly interim dividend of 2s. per ordinary share.

MARKET QUOTATIONS.

Wednesday, September 18th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	88/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£26	£4 dec.
a Lead, Nitrate	per ton	£34	..
a ,, White Sugar	per ton	£35	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a ,, Chlorate	per lb.	8½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	22/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a ,, Cyanide (basis 100 %) ..	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£150	..
b ,, Wire, in ton lots ..	per ton	£177	..
b ,, Sheet, in ton lots ..	per ton	£163	..
p Babbitt's metal ingots	per ton	£56 to £172	dec.
c Brass (rolled metal 2' to 12') basis	per lb.	7½d.	1d. dec.
c ,, Tube (brazed)	per lb.	10d.	1/32d. dec.
c ,, ,, (solid drawn)	per lb.	8¼d.	1/32d. dec.
c ,, Wire, basis	per lb.	8¼d.	⅛d. dec.
c Copper Tubes (brazed)	per lb.	10⅝d.	1/32d. dec.
c ,, ,, (solid drawn) ..	per lb.	11d.	1/32d. dec.
g Copper Bars (best selected) ..	per ton	£88	£8 dec.
g Copper Sheet	per ton	£88	£8 dec.
g ,, Rod	per ton	£88	£8 dec.
c ,, (Electrolytic) Bars ..	per ton	£75	£13 dec.
c ,, ,, Sheets ..	per ton	£86	£12 dec.
c ,, ,, Rod ..	per ton	£79	£12 dec.
c ,, ,, H.C. Wire ..	per lb.	9¾d.	1/32d. dec.
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/7½	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	4/7	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	54/6	1/1½ dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£20 10 to £20 15	7/6 inc.
g ,, ,, Sheet	per ton	£20 17 6	7/6 inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 5	inc.
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/2¼ to 1/4	..
p ,, rolled bars & rods	per lb.	1/3½ to 1/5	..
p ,, ,, strip & sheet	per lb.	1/5 to 1/7	..
o Platinum	per oz.	110/-	..
e Silicium Bronze Wire	per lb.	11½d.	3½d. dec.
Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£158 to £159	£10 10 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/2	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£45 to £70	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£26	£2 dec.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Telegr. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Direct West India Cable Co.—The net profit for the year ended June 30th was £2,098. A further dividend of 3 per cent. is recommended, making 6 per cent. for the year. £298 is carried forward. The earthquake which occurred at Kingston on January 14th caused the interruption of the Turks Island-Jamaica section until February 23rd, and the Bermuda-Turks Island section was interrupted from March 14th to April 7th. The revenue account has been debited with £7,276 expended in repairs, and credited with £298 surplus revenue, and now stands at £29,147.

Halifax and Bermudas Cable Co.—A further dividend of 2½ per cent. is recommended, making with the interim dividend paid, 5 per cent. for the year ended June 30th. £682 is carried forward.

STOCKS AND SHARES.

Tuesday Afternoon.

This week it is the threatened railway strike that overshadows all other matters of financial interest. Whether the men will strike, or whether a pacific agreement will be arrived at within the next six weeks, is the absorbing topic of discussion. Quotations for Home Railway stocks have been sharply affected, and the contagion has not left electrical railway securities untouched.

Central Londons are again lower, the strike fears coming on top of poor traffics to further weaken the market. While the Preferred stock remains steady, both the Ordinary and Deferred have given way, the former being 4 points down. City and South London had risen to 47 prior to the Manchester meeting, but the price eased off to 46. Metropolitans drooped to 39½, Districts to 11¼. Underground profit-sharing notes are still called 56½ as the middle price, but there is hardly any market in them.

Every trade is so greatly dependent upon railway facilities of communication that there is much hesitation in making prices in the case of industrial shares lacking a free market. Investors are not selling to any extent, so far, but the uncertainty stops people from buying, and so renders negotiation more difficult than before. Electricity supply shares are dull and lifeless. The only pleasant spots to be found in this department are the Debenture stocks, which have come a little into demand, Chelsea Debenture is up 1 per cent., and so are City of London Second Debenture and Charing Cross Fours. Similar securities in the other companies are without quotable change, but are not easy to buy in every case at the quoted levels, which are often more or less nominal.

The shares in the electricity supply list, however, are weak. Declines are marked against County Ordinary, London Electric Preference, Metropolitan Preference, South Londons and St. James' Ordinary, while the provincial shares have also weakened in several instances.

Dick, Kerr & Co. announce the handsome profit of £80,475 for the past financial year, and after the payment of 10 per cent. on the Ordinary, the sum of £79,140 is to be carried forward. This latter is equal to 6s. per share on the Ordinary, the price of which remains at 1½, at which the yield works out to £6 13s. 4d. on the money.

India-rubber shares are 10s. down at 14½. With each rise in the prices of the now popular gamble, Rubber shares, the quotation for India-rubbers quietly recedes. British Insulated Ordinary are down ½ to 6¾, but this is accounted for by the dividend of 4s. per share. Both the Brush Debenture stocks have been lowered 2 points. The British Aluminium Company has declared a dividend of 7 per cent. on the Ordinary shares, the prices remaining unaltered. Crompton Debentures rose a point.

British Columbia Electric stocks are good, particularly the Preferred Ordinary and the Debentures. Anglo-Argentines spurted to 8⅞ upon their coming conversion into 10 per cent. Preference shares, but the Belgrano group is stationary. A new issue by the Canadian General Electric Company may be out before these jottings are; it was decided to offer Preferred stock. British Electric Traction Preference fell to 6½.

The same investment demand which put up Debenture stock prices in the electric lighting list is responsible for advances in some of the telegraph prior-charge securities. The gains mostly do not exceed ½ per cent., but the movement is a welcome sign of the investor's presence despite the money market, the railway fears and other such distributing factors. Copper, the metal, has slumped with severity within the past few weeks, and the fall, which dragged American Rails and Copper shares into heavy declines, is regarded with satisfaction in the Telegraph market, as likely to aid economies in the companies' balance-sheets.

Direct United States shares have weakened, and Globe Telegraph Preference declined to 13¼. There has, however, been a rise to 17s. 6d. in Marconi's Wireless Telegraph.

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—

Friday, September 27th.—Shawinigan Water and Power Co.—Scrip (fully and partly paid) for £200,000 4½ per cent. perpetual consolidated mortgage debenture stock.

And has ordered the undermentioned securities to be quoted in the Official List:—

Montreal Water and Power Co.—Further issue of £67,000 first mortgage 4 per cent. prior lien gold bonds, registered, Nos. 3,273 to 3,942, of £100 each.
Shawinigan Water and Power Co.—Scrip (partly paid) for £200,000 4½ per cent. perpetual consolidated mortgage debenture stock.

Sao Paulo Tramway, Light and Power Co., Ltd.—A quarterly dividend of 2 per cent. has been declared.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Sept. 10th.	Closing Quotations Sept. 17th.	Business done week ended Sept. 17th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent
												£ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	6½s.	2½%	3½%	3½%	60 — 63	60 — 63	..	..	..	6 3 0
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5¼%	6 %	6 %	105 —106	104½—105½	105	104½	— ½	5 13 9
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	¾%	1¾%	17⅞ — 18	17⅞ — 18⅛	18 7/16	17 13/16	+ ⅛	9 11 9
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	.. ..	..	5 %	5 %	99 —102	99 —102 xd	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	6 15/16	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	91¼ — 93½	91½ — 93½	92½	91½	..	4 5 7
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6½ — 7½	6½ — 7½	..	..	..	6 13 4
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15⅞ — 16⅛	15⅞ — 16⅛	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710	Direct United States Cable	20	3 %	3½%	4½%	4⅝%	14½ — 15	14⅜ — 14⅞	14⅜	14⅜	— ⅛	5 17 3
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99½—101½	100 —102	..	..	+ ½	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	132 —137	132 —137	134	132½	..	5 2 2
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	86½— 88½	86 — 88	86	..	— ½	3 19 7
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104¼	103½	..	3 19 1
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜ — 13½	12⅜ — 13½	13½	12 13/16	..	5 5 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104	102½—104½	104	..	+ ½	3 16 7
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	97½—100½	97⅝—100⅝	..	..	..	3 19 7
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98½—100½	100 —102	..	..	+1	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5⅝%	5½%	5½%	10½— 10⅝	10½— 10⅝	10⅝	10½	..	5 2 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜ — 13¾	13⅜ — 13¾	13 3/8	13⅜	— ⅛	4 7 3
150,000	Great Northern Telegraph, of Copenhagen. ..	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	..	..	..	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99½—101½	100 —102	..	..	+ ½	4 8 3
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56 — 58	55 — 57	56½	55½	—1	5 14 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	67 — 70	66 — 69xd	..	..	..	5 1 5
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	67 — 70	66 — 69xd	..	..	..	5 15 11
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜ — ⅜	⅜ — 1	17/6	..	+ 7/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1 3/16 — 1 1/16	1 3/16 — 1 1/16	20/-	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1 — 1	1 — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —108	106 —108	107	106½	..	5 11 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	105 —107	105½—107½	107½	106	+ ½	4 19 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	12½	..	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	11½	11	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5 5/8	5 7/16	..	4 10 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..	3 1 3
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..	3 18 1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6½%	6½%	7 %	7 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	92½	..	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839†	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	7½	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	128½	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅞ — 7⅛	6¾ — 7⅛ xd	6¾	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..	..	4 10 11
15,60 l	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10¼	10 — 10¼	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1¼ — 1⅜	1¼ — 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930. ..	10	7 %	7 %	7 %	..	12⅝ — 13⅜	12⅝ — 13⅜	13½	13	..	5 5 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	7/16 — 9/16	7/16 — 9/16	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7⅛ — 7⅜	7⅛ — 7⅜	7 1/8	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½ — 7½	6½ — 7½	..	..	..	Nil
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	99½	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8 1/16 — 8 5/16	8¼ — 8½	8 7/16	8 5/16	+ 1/16	4 14 1
266,007	Do. 5½ % Cum. Prefs., 1 to 266,007 ..	5	5½%	5½%	5½%	5½%	5⅝ — 6⅜	5⅝ — 6⅜	6⅛	6 1/16	..	4 8 11
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
830,000	Babcock & Wilcox, 1 to 530,000	1	17 %	20 %	20 %	20 %	3⅜ — 4	3⅜ — 4	..	..	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	3 13 10
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4⅜ — 5⅛	4⅜ — 5⅛	97/6	..	..	6 13 4
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	5 — 5⅛	5 — 5⅛	5 1/8	..	..	6 7 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 14 3
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	96 — 99	96 — 99	96½	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	127 —132	127 —132	129½	128½	..	4 10 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	110 —114	111 —115	..	..	+1	4 6 11
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —107	104 —107	..	..	..	4 13 6
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —103	102 —104	102½	..	+1	4 6 7
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2½ — 2⅝	2⅜ — 2⅝	46/3	..	..	Nil
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	6⅜ — 6¾	6½ — 6¾	6½	6 3/4	— 1/8	8 17 9
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	100—103	100 —103	..	..	..	4 17 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	..	..	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6⅞ — 7⅛	6⅞ — 7 xd	6 15/16	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	6 1/16	5 15/16	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89 xd	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	60 — 65	60 — 65	..	..	..	6 3 1
50,000	Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅜ — 1⅝	⅜ — 1⅝	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	85 — 88	83 — 86	..	..	—2	5 4 8
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	70 — 73	68 — 71	..	..	—2	6 6 9
100,000	Buenos Ayres & Belgrano, 1 to 100,000 ..	5	3 %	4 %	3 %	3 %	4⅜ — 4⅝	4⅜ — 4⅝	90/-	88/4½	..	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	25	98/9	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅜ — 7¾	7⅛ — 7⅜	7⅜	..	..	6 3 3
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜ — 10⅜	9⅜ — 10⅜	9⅜	..	..	7 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105⅛—107⅛	105⅛—107⅛	..	..	..	4 3 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛ — 1 3/16	1⅛ — 1 3/16	25/6	24/6	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	71 — 73	67 — 69	70	68½	—2	5 15 11
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	89 — 91	89 — 91	..	..	..	4 7 11
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	51 — 53	..	..	—2½	7 10 11
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2¼%	44 — 46	45 — 47	46½	45½	+1	4 10 5
55,000	Crompton & Co., Nos. 1 to 55,000	3	2½%	2½%	2½%	5 %	1⅞ — 2 1/16	1⅞ — 2 1/16	..	..	..	7 5 5
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	96 — 99	..	..	+1	5 1 0

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sept. 10th.	Closing Quotations Sept. 17th.	Business done week ended Sept. 17th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1⅜ — 1⅝	1⅜ — 1⅝	30/7½	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1¼	1 — 1¼	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	102½	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5⅝%	6%	6%	6 %	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅝ — 13⅜	12⅝ — 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	..	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	9 8 3
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	..	2¼ — 2⅜	2¼ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
31,390	Do. — do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	⅛ — ⅛	⅛ — ⅛	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	4 4 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1⅞ — 1⅞	1¼ — 2 xd	..	..	+ ¼	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10⅝	10⅛ — 10⅜	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	105½	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11½ — 12½	11½ — 12½ xd	11 1/16	..	..	6 2 5
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛ xd	..	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105¼ —107½	105¼ —107⅝	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14½ — 15⅝	14 — 15	14⅜	..	— ½	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	1⅛%	1½%	Nil	Nil	1⅞ — 2	1⅞ — 2	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7⅛ — 8	7⅛ — 8	..	..	..	5 14 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 0 0
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 0 0
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8¼ xd	7⅞ — 8⅜	8¼	8 1/16	..	5 14 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/32 — 5/32	3/32 — 5/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	23/32 — 25/32	23/32 — 25/32	17/6	..	..	5 2 7
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	94	..	..	4 10 11
30,000	Peebles (B.) & Co., 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	3¾ — 4	3¾ — 4	..	..	..	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 1/8	1/16 — 1/8	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — ¼	⅛ — ¼	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33	31 — 33	32½	..	..	5 9 1
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½ —102½	99½ —102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	55 — 58	55 — 58	..	..	..	8 14 1
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3¼ — 4⅛	3¼ — 4⅛	81/3	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅜ — 5½	4⅜ — 5½	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7½ — 8½	7½ — 8½	7⅞	..	..	6 1 3
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞ — 8¼	7⅞ — 8¼	..	..	..	4 4 10
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3¾ — 4	3¾ — 4	72/6	..	..	6 5 0
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3¾ — 4	3¼ — 4	75/-	..	..	5 12 6
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜ — 3⅞	3⅜ — 3⅞	70/-	..	..	5 16 2
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	96 — 98	97⅞	..	..	4 1 8
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3½ — 4¼	3 — 4 xd	..	..	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101 —104	102 —105	104	103½	+1	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	9 — 10	..	..	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10½ — 11¼	10½ — 11¼	..	..	..	5 4 4
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	96 — 99	97 —100	..	..	+ ½	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4⅛ — 5	4⅜ — 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅛ — 5	4⅜ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7 — 8	6¾ — 7⅜	7¼	7	..	6 9 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 11	10 — 11	10 15/32	..	— ½	5 9 1
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	94 — 97	94 — 97	94½	..	..	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅛ — 1	⅛ — 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1⅛ — 2	1⅛ — 2	..	..	..	7 10 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞ — 5⅜	4⅞ — 6⅜	..	..	..	5 2 4
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅞ — 7¼	6⅞ — 7¼	7	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8¼ — 9¼	8¼ — 9¼	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 1⅝	1⅜ — 1⅞	..	..	..	6 8 0
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 5	4⅜ — 4⅝	90/-	88/1½	— ⅛	6 3 1
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	88 — 92	88 — 92	..	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	4⅜ — 5⅜	4⅜ — 5⅜	5 1/16	5	..	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 6⅜	4⅜ — 5	..	..	— ⅛	4 7 10
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 10 0
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	6¼ — 7	6⅜ — 6⅞	..	..	— ¼	5 18 6
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	11 — 12	..	..	..	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5⅞ — 6⅜	5⅞ — 6⅛ xd	..	..	..	5 9 10
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅜ — 8⅜	7⅛ — 8⅛	7¾	..	— ¼	5 17 8
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅝ — 7⅜	6⅝ — 7⅜	..	..	..	4 14 11
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	½ — 1½	½ — 1½	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2 — 2½	1⅞ — 2⅛	4⅛	..	— ⅛	7 1 2
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅜ — ½	⅜ — ½	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1⅛	1 — 1⅛ xd	..	..	..	5 12 0
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..	11 2 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	2 — 3	..	..	..	8 6 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8¾ — 9⅛	8½ — 9⅛	..	..	..	6 6 4
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5 — 5⅛	5 — 5⅛	5⅛	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent., August 15th 1907.

A METHOD OF DETERMINING THE LEADING DIMENSIONS OF LARGE AND HIGH-SPEED CONTINUOUS-CURRENT DYNAMOS.

By H. M. HOBART, M.Inst.C.E., and A. G. ELLIS, Assoc.A.I.E.E.

(*Concluded from page* 443.)

Other things being equal, it is desirable to have a machine with magnet cores of circular cross section, a low reactance voltage,* a low peripheral speed of commutator, and a low total works cost. The low peripheral speed of commutator must not be purchased at the expense of undesirably thin commutator segments. There appears, however, no sufficient reason for objecting, even in large machines, to segments with a thickness, including insulation, of not less than 5 mm. at the surface, and in small machines, segments of considerably less thickness are widely employed and with advantage.

For preliminary purposes, the commutator peripheral speed is estimated on the assumption that the width of segment plus insulation at the periphery of the commutator is equal to 5 mm. Where this thickness leads to a needlessly low peripheral speed, the commutator may, at a later stage of the calculations, be increased in diameter and decreased in length.

For more precise determinations of the reactance voltage we must apply a correction, as already briefly explained on p. 396. Thus let us take the case of the 12-pole 6,000-ampere-turn design of Table II. The reactance voltage as given on the chart for $D = 153$ and $\lambda_g = 56$, and a rated output of 500 KW., is 4·0 volts. But this is on the assumption of a design with 150 armature ampere-turns per centimetre of gap periphery, whereas from the curve in fig. 4 some 143 armature ampere-turns per centimetre of gap periphery is given as representative for 500 KW. rated output. For a design in which we retain the above values of D and λ_g (*i.e.*, 153 and 56), and use this representative value of 143 for the armature ampere-turns per centimetre of gap periphery, the armature strength per pole is in reality only—

$$\tfrac{143}{150} \times 6{,}000 = 5{,}700,$$

and the reactance voltage is only—

$$\tfrac{143}{150} \times 4{\cdot}0 = 3{\cdot}8.$$

Of course, in this instance, it would be an utterly misplaced and futile effort at exactness to apply the correction, but in cases where we are dealing with designs for much smaller rated outputs—take, for instance, a machine for some 50 KW. rated output—we see from fig. 4 that the value of the armature ampere-turns per centimetre of gap periphery is more of the order of 115, and in this case the application of the correction to the armature strength in ampere-turns per pole, and to the reactance voltage, is essential. For the rating taken to illustrate this point, *i.e.*, for a design for a rated output of some 50 KW., the reactance voltage is only some $\frac{115}{150}$, *i.e.*, some 77 per cent. of the value read from the charts. Obviously, the application of this correction is an exceedingly simple matter, and should be kept in mind for ratings materially below those with which this article is chiefly concerned.

The precise estimation of the total works cost is a matter to be treated with considerable care, but for purposes of rough preliminary comparison, it is sufficient to take the total works cost as proportional to $D \times (\lambda_g + 0{\cdot}7\,\tau)$, where—

D = Diameter at air gap in centimetres;
λ_g = Gross core length in centimetres;
τ = Polar pitch in centimetres.

This quantity, $D \times (\lambda_g + 0{\cdot}7\,\tau)$, if multiplied by a factor K, which varies for different types and sizes of machine,

* This is not such an important feature of an interpole machine as it is in the case of a machine without interpoles, except in cases of large rated output at extra high speeds where the reactance voltage must in any case be very high, and where even interpoles cannot be relied upon for ensuring satisfactory results.

TABLE III.—Alternative Trial Designs for a Rated Output of 500 KW., 250 R.P.M., 250 Volts.

		Armature ampere-turns per pole.					
		5,000	6,000	7,000	8,000	9,000	10,000
$\frac{I}{p} = 250$. N = 16·7. 8 poles.	Armature dia. — D	...	...	120	136	153	...
	Gross length — λ_g	...	...	56	40	32	...
	Pole pitch — τ	...	...	47	53	59	...
	$D \times (\lambda_g + 0{\cdot}7\,\tau)$	...	...	10,600	10,500	11,200	...
	Reactance voltage — R V	...	...	5·5	5·0	4·8	...
	Arm. periph. speed — s_a	...	...	15	17	19·5	...
	Com. periph. speed — s_c	...	...	4·7	5·4	6·0	...
	Arm. turns per pole — T	...	...	28	32	36	...
	$\frac{\lambda_g}{\tau}$	...	...	1·2	0·75	0·55	...
$\frac{I}{p} = 167$. N = 25. 12 poles.	Armature dia. — D	...	153	178	204	...	...
	Gross length — λ_g	...	32	24	18	...	...
	Pole pitch — τ	...	40	47	53	...	...
	$D \times (\lambda_g + 0{\cdot}7\,\tau)$	...	9,200	10,000	11,200	...	...
	Reactance voltage — R V	...	4·6	4·3	4·0	...	...
	Arm. periph. speed — s_a	...	20	23	26	...	...
	Com. periph. speed — s_c	...	9	10·6	12·0	...	...
	Arm. turns per pole — T	...	36	42	48	...	...
	$\frac{\lambda_g}{\tau}$	...	0·8	0·51	0·34	...	...
$\frac{I}{p} = 125$. N = 33. 16 poles.	Armature dia. — D	170	204	238	...	...	...
	Gross length — λ_g	28	20	14	...	...	...
	Pole pitch — τ	33	39	46	...	...	...
	$D \times (\lambda_g + 0{\cdot}7\,\tau)$	8,600	9,800	11,000	...	...	...
	Reactance voltage — R V	4·0	3·8	3·7	...	...	...
	Arm. periph. speed — s_a	21·5	26	31	...	...	...
	Com. periph. speed — s_c	13·5	16	19	...	...	...
	Arm. turns. per pole — T	40	48	56	...	...	...
	$\frac{\lambda_g}{\tau}$	0·85	0·51	0·31	...	...	...

Note.—All peripheral speeds are in metres per second.

TABLE IV.—Alternative Trial Designs for a Rated Output of 500 KW., 500 R.P.M., 250 Volts.

		Armature ampere-turns per pole.					
		5,000	6,000	7,000	8,000	9,000	10,000
$\frac{I}{p} = 334$. N = 25. 6 poles.	Armature dia. — D	...	...	89	102	114	...
	Gross length — λ_g	...	...	50	40	32	...
	Pole pitch	...	...	46	53	50	...
	$D \times (\lambda_g + 0{\cdot}7\,\tau)$	...	...	7,300	7,800	8,300	...
	Reactance voltage — R V	...	...	8·0	7·8	7·5	...
	Arm. periph. speed — s_a	...	...	23	26	30	...
	Com. periph. speed — s_c	...	...	5·2	6·0	6·8	...
	Arm. turns per pole — T	...	...	21	24	27	...
	$\frac{\lambda_g}{\tau}$	...	...	1·1	0·75	0·54	...
$\frac{I}{p} = 250$. N = 34. 8 poles.	Armature dia. — D	...	102	120	136	170	...
	Gross length — λ_g	...	40	27	23	15	...
	Pole pitch — τ	...	40	47	53	66	...
	$D \times (\lambda_g + 0{\cdot}7\,\tau)$	...	6,960	7,200	8·160	10,400	...
	Reactance voltage — R V	...	6·8	6·3	6·2	6·0	...
	Arm. periph. speed — s_a	...	27	31	35	44	...
	Com. periph. speed — s_c	...	8·0	9·5	10·5	12	...
	Arm. turns per pole — T	...	24	28	32	36	...
	$\frac{\lambda_g}{\tau}$	...	1·0	0·58	0·44	0·23	...
$\frac{I}{p} = 167$. N = 50. 12 poles.	Armature dia. — D	127	153	179	...	...	...
	Gross length — λ_g	25	18	14	...	...	...
	Pole pitch — τ	33	39	46	...	...	...
	$D \times (\lambda_g + 0{\cdot}7\,\tau)$	6,100	6,900	8,200	...	...	...
	Reactance voltage — R V	6·0	5·8	5·5	...	...	...
	Arm. periph. speed — s_a	33	40	47	...	...	...
	Com. periph. speed — s_c	15	18	22	...	...	...
	Arm. turns per pole T	30	36	42	...	...	...
	$\frac{\lambda_g}{\tau}$	0·76	0·46	0·31	...	...	...

Note.—The peripheral speeds are in metres per second.

gives a fair approximation to the total works cost. For the purposes of a preliminary study, however, we may neglect K and compare the total works cost as expressed in terms of

$$D \times (\lambda_g + 0{\cdot}7\,\tau).$$

At the time of the preparation of a schedule such as that in Table II, the endeavour should be made to avoid entering up inevitably undesirable designs. The remaining instances, *i.e.*, those which appear likely to come within the range of possible usefulness, are subsequently compared, and a convenient means of carrying out this comparison consists in plotting such a series of curves as those given in fig. 8.

From these curves we see that the total works cost is the least with the greater number of poles, with a moderate diameter and with low armature strength. The eight-pole design is inferior both as regards total works cost and commutation, and is withdrawn from further comparison. The commutator peripheral speed is very low for all the designs, being 11 metres per second for the largest diameter. Taking this into consideration, we should, at a later stage of the calculation, substitute a thicker commutator segment and employ a shorter commutator of larger diameter.

The 12-pole designs as compared with the 16-pole designs have somewhat higher reactance voltage, but there is very little choice between them as regards total works cost, as may be seen from Table II. On the whole the comparison is slightly in favour of the 16-pole designs. The preferable design will have a diameter of some 230 cm. and a ratio of $\frac{\lambda_g}{\tau}$ of 0·60. This ratio permits of employing a circular section of magnet core.

In the course of working out this design more in detail, it may prove desirable to depart considerably from this outline —indeed, it is usually best to work out several alternative designs. It is intended here merely to indicate a method of arriving at a reasonably sound starting point.

A 12-pole design with an armature diameter of 200 cm. is also well within the range of being practicable, for, although the reactance voltage is a trifle higher, the reduced commutator peripheral speed is so low on the reference basis of 5 mm. segments that the final design of commutator can have a considerably increased diameter and decreased length. Some of the leading data of these 12 and 16-pole designs are as follows:—

No. of poles	12	16
Air-gap diameter D	200	230
Gross core length λ_g	35	27
Relative T.W.C.	14,000	13,300
Arm. amp.-turns per pole ...	8,100	6,700
Reactance voltage	3·0	2·8
Commutator peripheral speed Sc. (5 mm. segments) ...	6	9

It would be neither necessary nor desirable to employ interpoles in either of these designs.

It is thus clearly indicated that 12, 14 or 16 poles and some 6,500 to 8,500 ampere-turns per pole in any one of these three cases, and a gap diameter of somewhere between 200 cm. for the 12-pole, and 230 cm. for the 16-pole design are the general order of magnitudes which should be employed as the basis for further trial designs.

It is often desirable to take two or more of the best designs with a given number of poles, and also for different numbers of poles, and work them out more in detail before determining upon the preferable design. However, for an extended comparison of a great number of different ratings, it is often impracticable on account of the limited available time, to thoroughly work out a number of alternative designs. Under such circumstances, it would appear reasonable in this instance to select the 16-pole design.

In a similar manner we have prepared schedules for 500-KW. 250-volt designs of 125 (the above design), 250, 500, 1,000 and 2,000 R.P.M., and corresponding sets of curves. These schedules and curves are set forth in Tables II to VI, and figs. 8 to 12.

From a perusal of these schedules and of figs. 8 to 12, we may prepare Table VII, showing the leading data of the preferable design for each speed.

In fig. 13 are plotted, in terms of the speed in revolutions per minute, the leading constants for the 500-KW. 250-volt designs. We have thus obtained, by selecting several designs for each speed from the chart in fig. 7, the outline data for a group of 500-KW. 250-volt designs at rated speeds of 125, 250, 500, 1,000 and 2,000 R.P.M. The obtaining of comparative characteristic features of these designs will suffice to illustrate the use of the method of procedure developed in this article.

The principal utility is the readiness with which comparisons may be effected, showing the influence of any one of the leading factors in the design. For example, we have now in fig. 13 a set of curves showing the influence of the

TABLE V.—Alternative Trial Designs for a Rated Output of 500 KW., 1,000 R.P.M., 250 Volts.

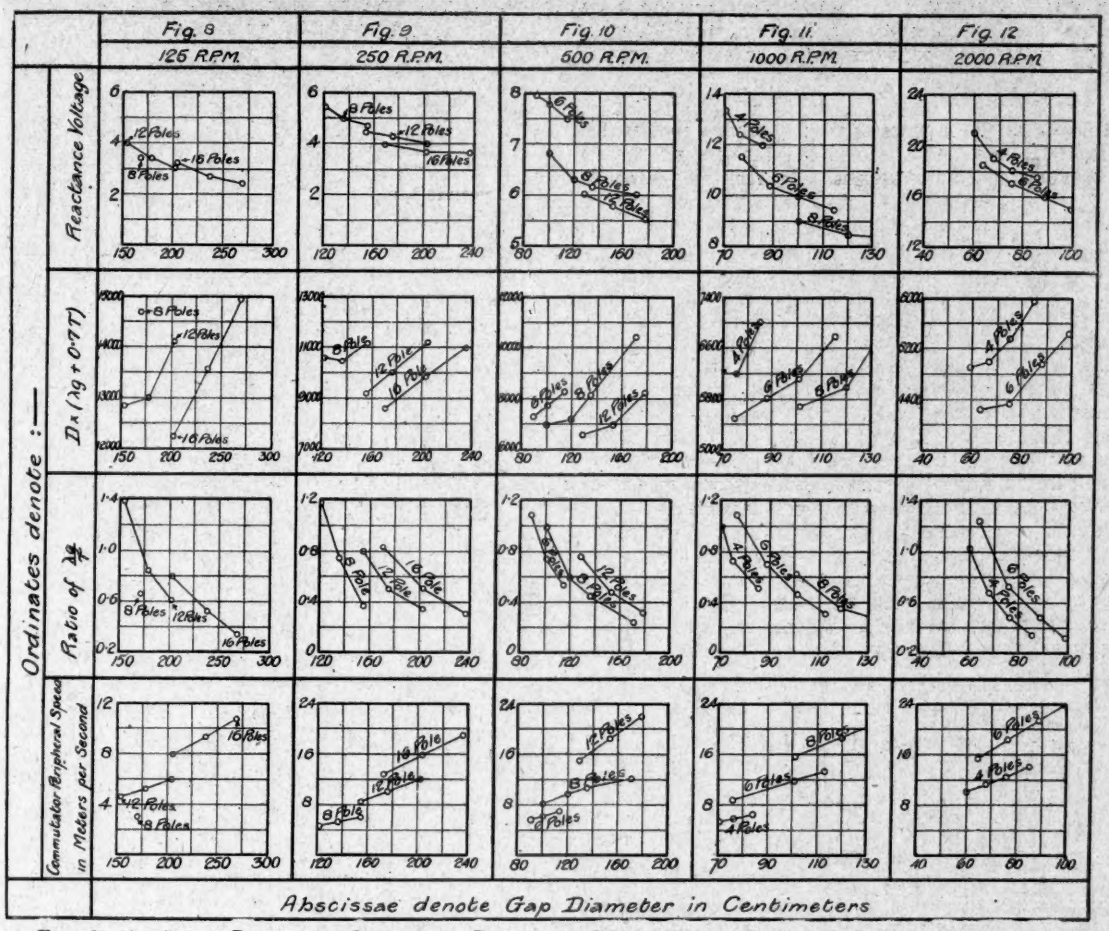
—	—	Armature ampere-turns per pole. 5,000	6,000	7,000	8,000	9,000	10,000
$\frac{I}{P}$ = 500. N = 33·4. 4 poles.	Armature dia. — D	...	...	...	68	75	85
	Gross length — λ_g	...	...	...	54	42	35
	Pole pitch — τ	...	...	...	53	58	67
	D × (λ_g + 0·7 τ)	...	...	...	6,200	6,200	7,000
	Reactance voltage — R V	...	...	...	13·5	12·5	12·0
	Arm. periph. speed — S_a	...	...	...	35	39·5	44
	Com. periph. speed — S_c	...	...	...	5·3	6·0	6·7
	Arm. turns per pole — T	...	...	...	16	18	20
	$\frac{\lambda_g}{\tau}$	...	...	...	1·0	0·73	·52
$\frac{I}{P}$ = 334. N = 50. 6 poles.	Armature dia. — D	...	76	88	102	114	...
	Gross length — λ_g	...	44	33	24	19	...
	Pole pitch — τ	...	38	46	52	59	...
	D × (λ_g + 0·7 τ)	...	5,300	5,800	6,100	6,800	...
	Reactance voltage — R V	...	11·5	10·5	10·0	9·5	...
	Arm. periph. speed — S_a	...	40	46	52	60	...
	Com. periph. speed — S_c	...	9·0	10·5	12·0	13·5	...
	Arm. turns per pole T	...	18	21	24	27	...
	$\frac{\lambda_g}{\tau}$	...	1·15	0·72	0·46	0·32	...
$\frac{I}{P}$ = 250. N = 66·7. 8 poles.	Armature dia. — D	...	102	120	136	...	...
	Gross length — λ_g	...	25	18	14	...	...
	Pole pitch — τ	...	40	47	53	...	...
	D × (λ_g + 0·7 τ)	...	5,500	6,100	6,900	...	...
	Reactance voltage — R V	...	9·0	8·5	8·3	...	...
	Arm. periph. speed — S_a	...	53	62	71	...	...
	Com. periph. speed — S_c	...	16·0	18·5	21·0	...	...
	Arm. turns per pole — T	...	24	28	32	...	...
	$\frac{\lambda_g}{\tau}$	...	0·61	0·38	0·26	...	...

Note.—The peripheral speeds are in metres per second.

TABLE VI.—Alternative Trial Designs for a Rated Output of 500 KW., 2,000 R.P.M., 250 Volts.

—	—	Armature ampere-turns per pole. 5,000	6,000	7,000	8,000	9,000	10,000
$\frac{I}{P}$ = 500. N = 66·4. 4 poles.	Armature dia. — D	...	...	60	68	76	85
	Gross length — λ_g	...	...	48	36	28	23
	Pole pitch — τ	...	...	47	53	60	67
	D × (λ_g + 0·7 τ)	...	...	4,860	4,960	5,320	5,950
	Reactance voltage — R V	...	...	21	19	18	17·5
	Arm. periph. speed — S_a	...	...	63	71	80	89
	Com. periph. speed — S_c	...	...	9·3	10·7	12·0	13·4
	Arm. turns per pole — T	...	...	14	16	18	20
	$\frac{\lambda_g}{\tau}$	...	...	1·0	0·68	0·47	0·34
$\frac{I}{P}$ = 334. N = 100. 6 poles.	Armature dia. — D	64	76	89	102	...	...
	Gross length — λ_g	42	29	22	16	...	...
	Pole pitch — τ	34	40	47	53	...	...
	D × (λ_g + 0·7 τ)	4,225	4,330	4,900	5,410	...	...
	Reactance voltage — R V	19	17	16	15	...	...
	Arm. periph. speed S_a	67	80	93	107	...	...
	Com. periph. speed S_c	15	18	21	24	...	...
	Arm. turns per pole T	15	18	21	24	...	...
	$\frac{\lambda_g}{\tau}$	1·24	0·725	0·47	0·3	...	...

Note.—The peripheral speeds are in metres per second.



Figs. 8—12.—Curves Relating to Preliminary Designs for 500-kw. 250-volt Continuous-Current Machines for Various Speeds, Plotted from Schedules in Tables II—VI.

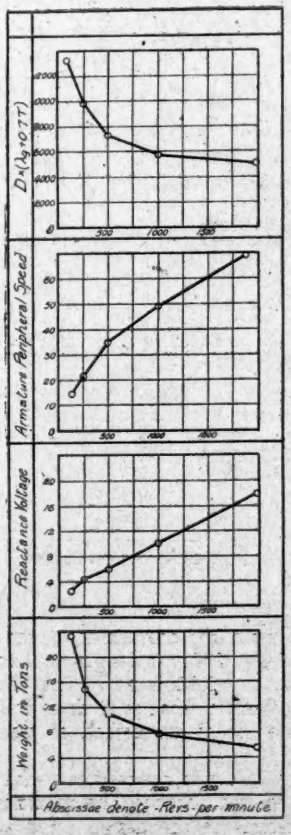


Fig. 13.—Data of 500-kw. 250-Volt Designs at Different Rated Speeds, Selected from Curves in Figs. 8—12.

TABLE VII.—500-kw. 250-Volt C.C. Machines for Various Speeds. Selected Dimensions from Figs. 8-12.

(All dimensions in cm.)

Speed in revs. per min.	125	250	500	1,000	2,000
Number of poles ...	16	12	10	6	4
Frequency in cycles per second — N	16·8	25	42	50	67
Armature diameter — D	230	170	135	95	70
Gross core length — λ_g	27	26	25	29	33
Pole pitch — τ	45	44	42	49	55
$D \times (\lambda_g + 0{\cdot}7\,\tau)$ ...	13,300	9,800	7,300	5,900	5,100
$\frac{\lambda_g}{\tau}$	0·6	0·6	0·6	0·6	0·6
$D^2 \times \lambda_g$	1,430,000	750,000	460,000	260,000	160,000
Arm. periph. speed — s_a	15	22	35	50	72
Arm. amp.-turns per pole	6,700	6,600	6,300	7,300	7,600
Current per circuit ...	125	166	200	333	500
Turns per pole T	53	40	32	22	15
No. of com. segments ...	850	480	320	132	60
Width of each segment ...	0·5	0·5	0·5	0·5	0·5
Com. peripheral speed—s_c	9·0	9·8	14	11	11·5
Reactance voltage ...	2·8	4·3	6·0	10·5	18
Total weight (metric tons)	23·5	15	11	8	6

Note.—The peripheral speeds are in metres per second.

rated speed on the characteristics of a 500-kw. 250-volt design. It will be observed that while the total weight and relative total works cost decrease at first fairly rapidly, these two curves become considerably flatter in the higher speeds.

The reactance voltage and armature peripheral speed increase very rapidly with the speed. Thus we have difficulties of commutation and mechanical construction incident to the high speeds, and we are not able, by means of these high speeds, to effect other than a small saving in tota weight and total works cost.

THE COMMERCIAL TESTING OF SERIES MOTORS.

With Particular Reference to those Designed for Diverter Control.

When large numbers of similar motors of, say, 5 H.P. and upward, are to be tested at the same time, some method of the Hopkinson type must of necessity be adopted, not only from reasons of economy but also on account of the large amount of generating plant, loading resistances and instruments which would otherwise be required.

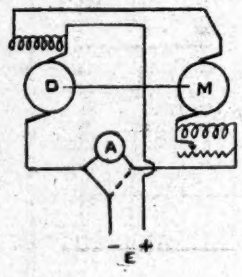
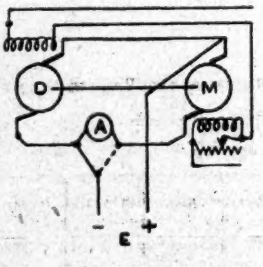
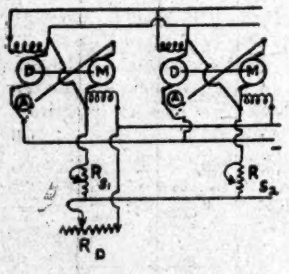
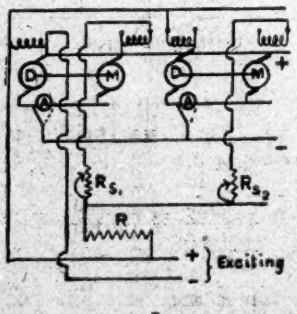
It is well known that series machines cannot be run satisfactorily when connected according to the Hopkinson methods used for shunt machines, a simple series or parallel arrangement being unstable. In devising suitable schemes of connections for testing large numbers of machines, all of which are to be subjected to a heat run of several hours' duration, it is of paramount importance that they should be as simple as possible and require little or no disarrangement of the normal connections; time is thus economised and unskilled labour may be used. These heat runs will usually be at the full rated output of the particular machines.

Ordinary series motors may for our purpose be divided into—

(*a*) Those in which the whole of the armature current always passes through the series field; such machines are those controlled by series-resistance and series-parallel arrangements of field coils and motors.

(*b*) Motors which are controlled wholly or in part by resistance shunted across the series field, and in which, therefore, the maximum field current will be less than the maximum armature current.

Under the conditions premised, any test in which the make-up power is supplied in the form of an added voltage is inadmissible, since a separate source of make-up would then be required for each pair of machines. All the tests described will therefore be of the type in which the two machines of each set are connected in parallel.

Diagram of connections.	Relative hands.	Normal Connections.	Regulation of load.	Mean efficiency η =	Remarks.
	Same	Unaltered	Resistance across motor field.	$\sqrt{\frac{E \cdot C_{AD} - C_{AM}^2 R_F}{E \cdot C_{AM} + C_{FM}^2 R_F - C_{AM}^2 R_F - C_{FM} C_{AM} R_F}}$	C_{AM} = armature current of motor. C_{AD} = do. do. of dynamo. C_{FM} = motor field current. R_F = resistance of field.
	Opposite	One field reversed	"		
	Same (or opposite)	Fields disconnected	"	$\sqrt{\frac{E \cdot C_{AD} - C_{FM}^2 R_F}{E \cdot C_{AM} + C_{FM}^2 R_F}}$	The fields of all machines under test in series and separately excited.
	Same	Unaltered	Coarsely by main diverter R_D. Each set by resistance R.	$\sqrt{\frac{E \cdot C_{AD} - C_{FM}^2 R_F}{E \cdot C_{AM} + C_{FM}^2 R_F}}$	The two fields of each set in series and all pairs of fields in parallel and separately excited.
	Opposite	One field reversed	"		
	Opposite	Unaltered	Coarsely by series resistance R. Each set by resistance R_S.	$\sqrt{\frac{E \cdot C_{AD} - C_{FM}^2 R_F}{E \cdot C_{AM} + C_{FM}^2 R_F}}$	All fields in parallel and separately excited.
	Same	One field reversed	"		

It should further be noticed that any particular test calls for a definite relation between the directions of rotation of a pair of motors as determined by the normal connections, if these connections are to be undisturbed when joining up for the test.

Motors of class (*a*) present little difficulty, the only point to be carefully observed is that the make-up supply leads are connected at the proper points as shown.

In motors of class (*b*) the ratio

$$\frac{\text{armature current at full load}}{\text{field current at full load}}$$

may reach a value of six or greater, depending upon the manner in which the load on the motor varies with its speed under actual working conditions. The field current at full load will be in all cases less than the maximum field current, and the drop of volts across the field will therefore be a small percentage of the armature potential difference. In short, it will usually be found advisable to supply all the fields of the motors under test from a separate source, either from a booster giving the low voltage required, or from a higher voltage supply through resistance frames; the former plan is undoubtedly to be preferred.

Of the four methods shown in the table, the first is applicable to motors of class (*a*), and the remaining three to motors of the second class (*b*).

Method II, though apparently simple and possessing the advantage that the excitation circuit may be run from a high voltage owing to the number of fields in series, suffers in practice from the drawback that one set cannot be added to or disconnected from a group without a complete shut-down, and the regulating diverters for each set cannot be grouped together at one spot. One ammeter in the exciting circuit will be found sufficient, though the current diverted from a motor field can be easily read if necessary.

Methods III and IV are similar; in III the two fields of a set are in series, and the sets are loaded by using one main diverting resistance, while IV calls for the connection of all fields in parallel, and the main regulation is by one series resistance. In practice the latter method has been found more convenient, and has proved very satisfactory.

The small regulating resistances (R_s) for fine adjustment of load are conveniently grouped all together with an ammeter, which, by suitable switching arrangements, may be inserted in each motor field circuit. This instrument should be of very low resistance.

REVIEWS.

The Physical Laboratories of the University of Manchester. A Record of Twenty-five Years' Work. Manchester: The University Press. Price 5s. net.

This volume was prepared last year to commemorate the twenty-fifth anniversary of the election of Dr. Arthur Schuster to a professorship at Owens College. The name of no individual compiler appears on the title-page or in the preface, but it is an open secret that the initiation of the project was largely due to Dr. Hutton, now lecturer in electrochemistry and assistant director of the physical laboratories. We understand that a large share of the work of collecting and editing the mass of biographical and other data contained in the book fell to him.

The volume forms an interesting record of the physical work which has been carried out by Dr. Schuster and his pupils during the past 25 years, and to those who are incessantly pointing us to Germany or America for our examples, it will be, we venture to think, somewhat of a surprise to study the account here given of what has been accomplished in pure and applied physics at a single British university.

The first physical laboratory work at Manchester was organised by Prof. Balfour Stewart on his election to the chair of physics in 1871, when eight students attended for instruction. At present the total number taking courses in physics is about 250. The reviewer remembers the three small and somewhat dingy rooms, facing the back of the college, which constituted the laboratories of Dr. Stewart in 1887, the last year he lectured. The volume traces the gradual development from these small beginnings to the erection of the present building, which was opened by Lord Rayleigh in 1900, and is undoubtedly one of the finest laboratories in the country.

A description of the new buildings and their equipment, with detailed particulars as to the courses of the laboratory teaching, forms the first part of the volume, and to anyone fitting up a similar institution, the excellent illustrations of the various departments will be of value. We understand that at least one new foreign laboratory has closely imitated several of the original ideas here detailed.

One of the most valuable parts of the book is the bibliography of the scientific papers of Prof. Schuster and his pupils, which occupies 80 pages. The subjects included cover a very wide range, but the influence of Prof. Schuster on the research, particularly of recent years, is easily recognisable.

An appendix contains the names of former professors and demonstrators in physics, and also of a number of distinguished physicists and engineers, who came into contact with Prof. Schuster while he was acting as honorary demonstrator or were pupils of his predecessors at the college. We notice among these the name of Prof. J. J. Thomson, who in 1875 attended Prof. Schuster's lectures on Maxwell's "Theory of Electricity," which had been published two years previously.

We have not space to enter into detail on more than one or two points. The laboratory contains, however, several features of unusual interest. The spectroscopic equipment in particular is unique. A large Rowland grating of 21½ ft. radius and 6 in. wide is mounted on a heavy framework of iron beams, with carriages so coupled that as the camera moves away from the slit the grating moves towards it. With this arrangement the different parts of the spectrum remain in focus whatever the position of the camera on the beam. A second and smaller Rowland grating, a Hilger echelon grating, a quartz spectrograph, and one of Prof. Kayser's ingenious machines for measuring spectrum photographs, printing automatically upon a tape the wave-length of any line under examination, are also provided. The reputation of Prof. Schuster as a spectroscopist, and these unusual facilities for research, have, as the records testify, attracted to Manchester a succession of capable investigators in this branch, not only from England, but from abroad.

Another development worthy of mention is the electrochemical laboratory, almost, we believe, the only one of its kind in England. The equipment here is very complete. It has been described elsewhere by Messrs. Hutton and Petavel, but a recent addition is an electric furnace capable of working under pressures up to 200 atmospheres, which is now being used in an extensive general investigation into electric furnace reactions.

The book under review is well printed and illustrated, the frontispiece being an excellent reproduction of a photograph of Prof. Schuster by Lafayette. There are practically no criticisms to make, unless it be of the necessarily somewhat "dictionary" style in which a part of the information is presented. The hieroglyphics on the plate facing p. 7 might to many people need considerable explanation.

We congratulate the University on the production of a book which will be of special interest to its students of physics, past, present and future.

Handy Copper Wire Tables and Formulæ. By P. B. Down. London: The *Electrician* Printing and Publishing Co., Ltd. 1907. Price 2s. 6d. net.

Most electricians sooner or later feel the want of a thoroughly trustworthy little book containing copper wire tables and formulæ. We can only, however, partially recommend this book, as it does not quite attain the very high standard of accuracy and lucidity which a book of this nature ought to satisfy. On page 5 we read that "These tables are calculated for a temperature of 60° F., and are based on a standard foot of soft copper wire weighing 1 grain, and having a resistance of 0·2186 B.A. units at 60° F." This lacks definiteness, as it is essential to know

the density of the copper forming the soft wire. On page 25 we read that a cubic centimetre of copper weighs 8·9 grammes (presumably at 60° F.), and that a cubic foot of copper weighs 555 lb. These statements, however, do not agree with one another. The E.S.C. very properly state that the specific gravity of copper is to be taken as 8·90, but that its density at 60° F. is 8·89.

Again, on page 25, we read that the increase of the resistance of copper due to temperature rise is 0·215 per cent. per degree F., but on page 29 it is given as 0·238 per cent. per degree F. The tables of the areas of small circles given on pages 20 and 21 do not agree very well with themselves. A cursory glance shows us that they contradict one another in eight places.

We cannot understand some of the "useful formulæ" given on page 24. For instance, "the length of different diameter wires used on the same voltage excitation, and at the same density per sq. in. is the same; it, therefore, follows that the ampere ft. vary only and directly with the diameter of the wire used under these conditions." The theorem enunciated in the first half of this sentence is fairly obvious, but the second half should be more fully explained. —A.R.

Electric Light and Power. By E. E. Brooks, B.Sc., and W. H. N. James. London: Methuen & Co. 1907. Price 4s. 6d.

This treatise maps out the ground which has to be explored by the student preparing for the preliminary grade examination, in electric lighting and power distribution, of the City and Guilds of London Institute. The arrangement and treatment of the subject show that the authors have an extensive practical experience of teaching, and many of the difficulties encountered by beginners are carefully cleared away. The knowledge presupposed is of the slightest, and yet the student who carefully reads this book will have widened his point of view, as the general physical laws are described with an accuracy which is often lacking in elementary books for engineering students. The book is up to date, and is laudably free from misprints. It can be recommended for the class of students for whom it is intended.—A. R.

Emden's Building Contracts, Building Leases and Building Statutes. By J. B. Matthews and W. V. Ball. London: Butterworth & Co. 1907. Price 27s. 6d.

This bulky volume is now in its fourth edition, an interval of over ten years having elapsed since the previous edition was published. Many cases have been tried, and many decisions given, during that period, and these have been incorporated as far as possible in the present issue. Many other improvements have been made in various parts of the work; new forms have been introduced, including the form of contract sanctioned by the Royal Institute of British Architects and forms relating to party walls, the London Building Acts of 1898 and 1905 are given in full, with notes, and the table of cases is entirely new.

The first part of the book, comprising 370 pages, treats of the law relating to building leases, contracts, buildings, easements, &c., in 27 chapters. Chapter 7 deals with the powers, duties and liabilities of the architect; much of this relates equally to consulting engineers, who occupy a similar position in their relations with the employer. Thus the appointment and remuneration of the architect, his rights in respect of plans and specifications, his duty, liability for negligence, authority, &c., are considered, with numerous illustrative cases, many of which are very interesting. Regarding the usual clause by virtue of which the decision of the architect (or engineer) is made final in respect of certificates for payment, it is significant that it has been held that under such circumstances it was not the architect's sole duty to protect the interests of the building owner against the builder; he owed a duty to the latter also, and he was bound to hold the scales evenly and to decide impartially as to the amount payable. An architect is liable for negligence in certifying, for permitting trespass, for preparing incorrect bills of quantities, for faulty design—and so is the engineer. A case is quoted where an engineer drew up a specification for machinery which practically gave the order to a particular firm, from which he received a secret commission; the contract was vitiated, the contractors were mulcted in damages, and the commission had to be repaid to the buyers. Further information of this kind is given in Chapter 8, on the approval of work, and certificates, matters which raise many nice points of law. Chapter 14 deals with "extras." In Chapter 26 the supply of gas, electricity and water is considered briefly.

Part II deals with forms and precedents for building contracts, leases, mortgages, &c., including a form of agreement with architect, and the schedule of charges sanctioned by the R.I.B.A.

Part III gives the statute law relating to building, and is followed by an appendix of unreported cases. The work concludes with a glossary of technical terms and a very full index, occupying no less than 88 pages.

It would be superfluous to comment at length upon the usefulness of a standard work such as this, which is practically indispensable to all builders, architects and owners.

BUSINESS-GETTING FOR SMALL STATIONS.

We hear nowadays a great deal about the possibilities of economy in production and of business-getting in systems of electric light and power supply of considerable magnitude, but it seems to be the fashion to ignore the existence of smaller central stations, which are at present supposed to be in the position of feebly struggling along until they are converted into the sub-stations of some very big supply authority. While it is undoubtedly true that, in the majority of cases, it is preferable to merge the small supply of this kind into a greater where a power-in-bulk supply main is accessible, as is instanced by the actions of the Tynemouth Corporation and the town of Calverley, in Yorkshire, it is also true that the possibilities of business-getting expansion in small town supplies are not yet adequately appreciated by those in charge. An excellent corrective of the despairing note very often found in the utterances of such unfortunate central station men as are harassed with the cares of small central station management may be found in an article by Mr. Frank H. Plaice, in the *Western Electrician* of August 3rd. He had the problem of a small central station working in a town of less than 1,500 inhabitants, and faced with the position that a 24-hour service was inevitable, unless competition was to have its own way. Such a condition of affairs was due to the fact that even such a small community was rapidly awaking to its rights and beginning to demand that its needs and conveniences should be considered by placing electricity on a par with gas and water, and its distribution throughout the 24 hours made universal.

In the case under consideration, this argument derived considerable potency from the fact that natural gas could be had in the district at 25 cents, or 1s. 0½d. per 1,000 ft., while coal could be obtained at 14s. 4d. per ton delivered. The central station was being driven by gas engines using natural gas. There were no public contracts, the company being dependent on commercial work alone, and the earnings at the time when the day service was commenced, that is to say, on May 1st, 1904, were slightly less than 16s. 8d. per head per annum. Under these conditions it was undoubtedly the best progressive policy to start the 24-hour service, and with that in view, a sliding scale of rates on the basis of a number of hours of service was decided upon.

The schedule, as finally worked out, was as follows:—For the first 7½ hours, 20 cents; for the next 7½ hours, 10 cents; for the following 15 hours, 9 cents; for 20 hours thereafter, 6 cents; for the next 30 hours, 3 cents; anything after this, 2 cents; or 7 cents for a three-hour service and 2 cents thereafter; with no minimum, no motor rental, and free renewals.

In order to determine the hours of service, neither the actual maximum demand, nor the maximum load installed was taken as a constant, but a figure which was based on the area to be lighted, and approximating three-fourths of a watt per square foot of floor area. The customer was allowed to install as many lamps and use as many units as might be desired, the one using the largest candle-power per square foot paying a much lower rate for his supply than the economical user who preferred small illumination. The object was to encourage or force a free use of electricity, and the rapidly falling hours-of-service rate was to enable the long-hour-service load to be charged as eeconomically as possible to the consumer.

It will be seen that Mr. Plaice in thus going back to the floor space to be lighted as his constant realised the fact, that, after all, the lighting station engineer is not ultimately concerned with the number of units he delivers to the consumer, but rather with the amount of light which that consumer gets. The consumer does not particularly care for any high science about his installation; all he wants is good lighting at a cheap rate. It is a mistake of many central station men in this country to talk about watts and amperes when they should be talking shillings and pence.

This tariff has in practice worked out well, the average output per month from this small station, which is of 250 KW. capacity, being 20,000 KW.-hours; the average return to the company is 5 cents per unit gross, and 1¾ cents per unit net.

It was decided to extend the existing free-wiring system for lighting to each and all equipments that a possible consumer might desire to make use of in connection with this day service. Such installations were placed on a rental basis, and a charge of 1 cent per month for $1 invested was made. The company has found this method very satisfactory, and in the scheme has included all classes of mechanical equipments, such as motors, shafting, pulleys, belts, wiring, fixtures (except arc lamps, for which no rental is charged), heating utensils of all kinds, and, in fact, everything that will increase the sale of energy.

The only contract that is required on such installations is one showing the ownership of each item of the installation, and indicating the company's power to remove its property at any time the company wishes to do so.

The extent to which this plan has been adopted is shown by the fact that, of the 370 services connected to the mains, nearly three-fourths feed installations belonging to the company.

The quality and constancy of the supply is as good as is found in most undertakings, and this is best shown by the fact that, during the two years' struggle with the local municipality with regard to the franchise of the company, not a single word was said against the quality of the service.

The question of advertising was, of course, up for consideration, and while it was admitted that open advertising was of great value in large places where the public had to be reached indirectly, it was felt that the canvasser in a small town of 1,500 inhabitants should be personally acquainted with everyone in the neighbourhood, rendering this form of advertising superfluous. Personal work was, therefore, taken as being the best return for money spent in advertising. It took, however, many forms. The electric company became the consulting engineer for as many mechanical enterprises as it could get hold of in its field of supply, even though, at the time, there was no opportunity of adding any electric service by such consulting work. This was done on the general principle of making oneself pleasant to one's clients.

Another method adopted was to install services on trial, as an advertisement. The company also negotiated the sale of such equipments as its work rendered unnecessary, which not only pleased the customer, but got dangerous competitive forms of apparatus out of the district. For example, the company dismantled gas or gasolene outfits as soon as ever electricity was installed, doing away with a future possibility that was unpleasant.

A most liberal policy with regard to services was taken by the company, as it never refused to carry its mains into premises for any service of 16 C.P. or over, the result being that the gas company acknowledged the damage that it received by sending a special agent into the town to see where its sales were going to.

A great point was made of electric flat irons as a day load, and the company managed to get something over sixty irons in service, setting up for itself quite a new kind of peak load. Nearly all its customers washed on Monday and ironed on Monday or Tuesday, so that about 10 o'clock on Tuesday morning, especially in the heat of summer, the current has been known to reach 150 amperes above the normal, and to last, except for a drop at noon, from 10 o'clock in the morning until 4 or 5 o'clock in the afternoon. Sewing machine and washing machine motors were also pushed for all they were worth, and turned out to be very good selling devices for electricity in the household.

The company also made a determined attempt to get hold of farm service, and got six miles of such service lines in operation, supplying a 24-hour service. Fifteen motors aggregating 50 H.P., and about 150 lamps were put on to the mains in this way, and one of the dairy farms outside the town installed the first electric milking outfit in the State of Ohio. The milking machine milks four cows at a time, and operates on 50 cows in 1½ to 2 hours. The cost of this to the farmer was about $6 a month for energy, and owing to the fact that it used to take three men six hours to milk those cows twice a day, the farmer was more or less satisfied. The only trouble that this station experienced with regard to its farmer-consumers was that occasionally one of the big farm motors would be suddenly started away on Sunday, making it necessary to run a big set on Sundays as well as on week days.

Eighty-five per cent. of the buildings in the town are wired electrically. Bare overhead wire is used, and on the lighting end two 250-volt lamps are wired up in series, a switch being placed on each pair of lamps. Every installation is protected by kicking coils and lightning arresters. All power motors are similarly protected, except the small ones close to the station. So far no shut-down by lightning has occurred.

These facts and figures give a striking illustration of the way in which American engineers are tackling the problem of supply to small communities in rural districts.

L.C.C. Staff and Tramway Patents.—The *Westminster Gazette* says:—"Officers of the London County Council are not allowed to take out patents without receiving special sanction. The necessary permission has now been given to one of the engineers, who has devised an improved point for use in connection with the side-slot system of conduit tramway electrical traction. The Council imposes the condition that it shall have the right of using the invention if it so desires."

SOME AMERICAN VIEWS ON EDUCATION.

Capacity for Service.

Under the above title a very interesting address upon the problems of education was delivered a short time ago before the Clarkson Memorial School of Technology, by Mr. F. R. Hutton, President of the American Society of Mechanical Engineers. Mr. Hutton began his address by defining the result of successful education as the ability conferred upon a student of being serviceable to his fellow men; and he defined the team "service" in an industrial community engaged in production as being the process of increasing wealth by the expenditure of labour upon a raw material or a product of the soil. Mr. Hutton divided the methods commonly employed in educating a youth into two classes, in the former of which a pupil was disciplined in mind by study, and perhaps in body, also by reasonable athletics; whilst in the latter he was sent to a school as to a fountain of information which he was to assimilate as quickly as might be. The former system produced a polished and outwardly cultured gentleman, so impressed with the perfection and inevitableness of classic models as to be discouraged and deprived of his sense of initiative, unless the latter quality were kept alive by athletics, college journalism, or the control of private musical or dramatic undertakings. The latter system, if allowed to be carried out to its extreme limit, tended to produce a student who had become a mere mass of absorptive tissue "taking in information and knowledge as did the dead sponge rather than by a process similar to that which was exhibited by a living tree." When, however, a scheme was followed which stood midway between the two extremes—when a man was forced to think correctly, persistently, and with a definite and positive object before him—then he would receive the most valuable education it was possible to give. In the words of Prof. Sweet, of Syracuse, the abilities of a student who had been trained in classics were limited to knowing what had been done and to doing it; whereas a student who had been so taught as not to deprive him of his initiative, knew what to do and how to do it.

Mr. Hutton went on to remark that the older American ideal, that education should be so directed as to fit each boy eventually to become President of the United States, had done harm in many respects. Only a very few scholars were ever able to rise to positions of such eminence as were indicated by this popular saying. The modern factory or commercial undertaking required servants of three kinds; productive agents, office assistants and salesmen. The bulk of the first class were tradesmen working with their hands or with tools upon a raw material, and they must always be in the majority; therefore, the educational system of a country should be primarily designed to meet their needs. They required a broad and practical education, one covering the scientific and natural principles involved in their daily life. The other members of the first class comprised the managers, the draughtsmen, the engineers, &c.—men who must thoroughly understand the crafts they had to control, but for whom a thorough working knowledge of science, and its laws was even more essential. The second employés, those engaged in the office and the counting house, were the smallest in numbers, and should be reduced to a minimum. They were best given a special commercial training such as was already afforded in business colleges and correspondence schools. In considering any form of scientific education offered for the training of men who had afterwards to assume positions of responsibility, it should always be remembered that the conditions prevailing at an educational establishment must inevitably be different from those obtaining in a factory. The unit or standard of measurement in real life was the "dollar," but that at college must be one which was not "a variable with expediency as its exponent." Mr. Hutton brought his address to a conclusion by quoting St. Paul's dictum that all things which were in accordance with Nature's laws were lawful for us, but that not all things were expedient. A man's training, he said, in what was practically or economically possible under Nature's laws, and what was, therefore, expedient, must be the function of life itself after school was left, for the best of teachers could only hint at such matters to his students during their educational careers.

The Proper Study of Mankind.

An address on somewhat different lines, but one in which its author insisted on the true aim of education, being the benefit of mankind at large rather than of the student himself, was also delivered before the Clarkson Memorial School of Technology last June by Mr. J. F. Hayford. Mr. Hayford pointed out in very cogent language that engineers are doing a great service to the world—a service much greater than the world appreciates, a service much greater than engineers themselves realise. Hence the author took for the text of his address, Pope's observation that the proper study of mankind is man. The successful engineer, he said, passed through three periods during his acquisition of knowledge and wisdom. The first period was that of the school and college where the student gained information from books and teachers; the second comprised the first ten years or so after leaving college, when he occupied subordinate positions and was in close contact with material facts; the third period was when the student began to fill a supreme or responsible post, where again he had to acquire knowledge at second-hand from his subordinates. When at school the student was generally learning things known long before, absorbing knowledge that had been well organised by many men, teachers and authors. Inasmuch as it was well organised, the knowledge came to the student with comparatively little colouring from the final author or teacher; but on the other

hand, it was highly coloured by having been handed down through a long series of professors who, by virtue of being teachers, were thinkers rather than doers. During the second period of the student's lifetime it was within his power to eradicate the inevitable bias of his college education, for he was enabled by his immediate contact with things to correct his former impressions. During the third period of the student's existence, when again he had unavoidably become dependent upon the brains of others for his information, he again suffered from the liability to accept highly-coloured statements—highly-coloured because of the peculiarities of the one man, or of the few men, from whom they were derived. Thus at all stages of the engineer's career, and especially in the last, when he should be of greatest service to the community, it was most necessary that he should study men, because he learnt through men. Such being the case, and language being the medium through which he communicated with other men, language became one of the tools of an engineer—a tool he has frequently neglected, because he has as frequently failed to realise that men also are his tools.

Mr. Hayford proceeded to criticise the common conception of a business organisation as being an arbitrary arrangement by which orders are transmitted through different grades of officials, from the man at the head of the enterprise to the man who do the actual work; whence it has followed that many qualified engineers have thought it necessary merely to give an order to ensure the work being done. That is not the system, said the speaker, on which a successful administrator manages the undertaking for which he is responsible. The successful administrator has three points to consider—first, that he puts his subordinates into such positions that they can do their best; secondly, that he gives them orders as to the work they do; thirdly, that he enlists their wills as well as their muscles in their work, so that they shall do their utmost. The ordinary student realises that he has to perform the second of these things, but he has scarcely thought at all of doing the first and last, which are vastly more important. Indeed, the truly successful administrator has so much of his time occupied in finding the proper place for each man and finding the proper man for each place, and also in convincing his subordinates of the correctness of his own views as to the best methods of achieving the desired result, that he has but little leisure left to give precise orders. Hence it is that in a large undertaking it is the chiefs who do the most difficult work, whose labours are the most intense and the most prolonged. No successful engineer can be trained entirely from books. There are, undoubtedly, fundamental principles capable of being put into books which are daily employed by men of affairs. But such men have neither the time nor the aptitude to write text-books. Books are written by men who tend rather to be successful authors than successful administrators; and to some extent, therefore, information contained in books is distorted. Naturally, however, the student must study the best books he can find, must study current work as shown in current literature, but must study facts and principles directly whenever he can.

In a very eloquent peroration, Mr. Hayford remarked that the soundness of a student's engineering knowledge must depend in part upon his knowledge of men, but what is still more important, that the effectiveness with which he used his engineering knowledge must depend very intimately upon his knowledge of men. Therefore, he must pay attention to all phases of the men around him, studying them for perfectly unmoral reasons, seeking neither to improve them nor to be improved by them, but seeing and appreciating them as literary, artistic and technical men, as men of feeling as well as men of thought, as incarnate motives as well as thinking and working machines. To achieve the highest success an engineer must display not only the power of quickly drawing correct conclusions from facts laid before him, but must have the power of drawing correct conclusions quickly from information given him by word of mouth. It was far more useful to the community that the engineer increase the output of each individual among a hundred men by 10 per cent. than that he increase his own output by 50 or even 100 per cent.

Educational Ideals.

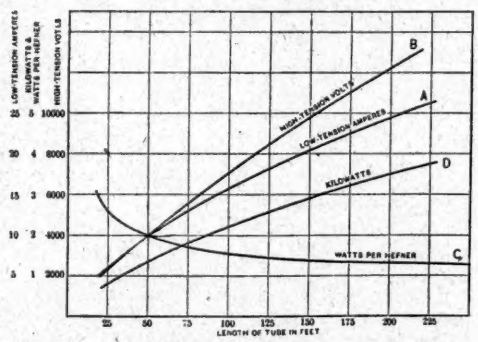
The third American address which may be dealt with on the present occasion is again one where service to mankind is held up as the ideal before the student. The address in question was delivered by Prof. A. L. Lowell, at Yale University a few months ago, forming the third of the annual Harvard lectures. Beginning his address with some references to the unpleasant aspects of commercial and political life that have become only too conspicuous in the States of late years, Prof. Lowell expressed the opinion that these phenomena have been due at least as much to a lack of moral standard as to a deliberate violation of recognised rules of honesty. It would be absurd, he said, to suppose that universities could manufacture standards of business morality, but they could help to diffuse the fundamental principles on which all morality must be based, and, what was far more important, they could bring men into that intellectual sympathy, that common way of looking at things, which must exist before an agreement on principles of any kind could be reached. Thus it followed that one of the chief duties of a university was to do what it is already striving to do, viz., to set up standards of life and thought, and thus create a national unity of principle. With this ideal before him, Prof. Lowell laid great stress on the advantage to the individual student and to the nation in general of the system, according to which a youth who graduated in one institution took a post-graduate course at another, became a demonstrator at a third, an assistant professor at a fourth, and a full professor elsewhere. At one time, he said, the Italian Government was in the habit of sending the young army recruit to a distant part of the country in order to break down local feeling and bring about both a stronger national sentiment and a greater sympathy between the different provinces of the country. In this respect Prof. Lowell brought forward for admiration the system prevailing at Oxford and Cambridge, whereby youths who have received their school education at the same establishment, or who lived in the same part of the country, did not collect unduly in one college or associate together to the exclusion of all others.

The whole tenour of Prof. Lowell's address was an insistence upon the desirability of sinking provincial in favour of national feeling, of using the university as an agency for the creation of patriots. For this reason, the bulk of his remarks do not directly concern us here, because, living in so much smaller a country, we do not probably produce schoolboys differing so largely in temperament and tradition as do the United States of America. Nevertheless, the figures quoted by Prof. Lowell which relate to the derivation of the students in some universities of the States are not without interest. He pointed out that, in certain typical endowed universities of North America, the State in which the university happened to be situated did not contribute more than 25 to 50 per cent. of the total number of students, that, indeed, most of the older establishments contained at least one student from almost every State in the Union. Conditions were somewhat different amongst the State universities, which were partly supported by taxation, for in only one of them was the proportion of students coming from outside the State anything like as large as 50 per cent. As a rule, about 85 per cent. of the students attending a State university belonged to the State in which the university was situated, but of course, many of the latter establishments made some distinction in the fees payable between students coming from the immediate neighbourhood of the institution and those coming from other parts of the country.

THE MOORE TUBE LIGHT.

In a paper read before the American Institute of Electrical Engineers in April last, particulars were given by the inventor, Mr. D. McFarlan Moore, of the latest developments of his system of illumination by means of vacuum tubes. The system in its earlier stages was described in our pages, and in our issue of June

Fig. 1.—Curves of Tube Performance.



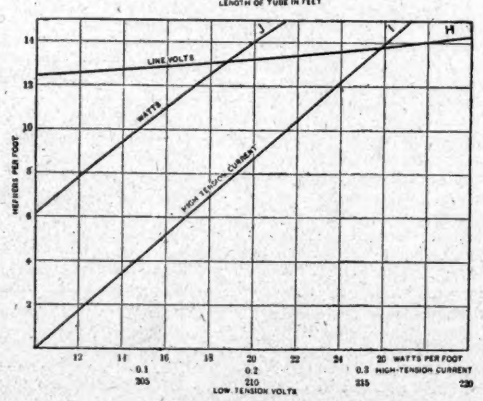


Fig. 2.—Variation of Luminosity with Pressure, Current and Power.

24th, 1898, we gave an illustrated account of it. While it cannot be said that the system has yet attained a marked degree of popularity, there is no doubt as to its remarkable properties and economic possibilities, and it comes nearer, in its production of light without heat, to the mysterious performances of the glow-worm and firefly than any other practical system of lighting yet devised. We may in brief remind our readers that Mr. Moore uses a "vacuum" tube such as every electrical student is familiar with, but of comparatively enormous length, supported round the walls of a room near the ceiling, or in any other advantageous positio-,

and excited by high-pressure alternating current. The electrical apparatus other than the tube itself is concentrated in a small box, which contains a transformer, the terminals of the tube, and a regulating valve. Starting from this box, the tube passes in one continuous length round the room, and returns to the box. The high-pressure connections are entirely enclosed in the steel terminal box, and it is impossible to obtain a shock from the tube, whether sound or broken. The tubes, which are about $1\frac{3}{4}$ in. in diameter, may be over 200 ft. in length, and require a terminal pressure of about 12,000 volts; the voltage is approximately proportional to the tube-length, as shown in fig. 1.

From the same figure it will be seen that the efficiency increases with the length of tube, rapidly at first and slowly from 100 to 200 ft. A 200-ft. tube absorbs a gross power of 3·5 KW., and gives out about 2,400 hefners. The light intensity soon becomes constant, and the efficiency also; a wide range of supply voltage has little effect on the efficiency, and the light intensity is directly proportional to the voltage and power. Fig. 2 shows the relations between hefners per foot and line volts (H), current (I) and watts (J).

The gaseous pressure in the tube is about 0·1 mm., and is maintained constant to 0·01 mm.; the nature of the gas contained in the tube determines the colour of the light, which is pure white with carbon dioxide, yellow with nitrogen. The most noteworthy improvement in the system has been the invention of an exceedingly ingenious automatic regulating valve, which was rendered necessary by the fact that in use the vacuum continually rises, and it is absolutely essential to introduce a supply of gas from time to time, to restore normal conditions. Fig. 4 shows the automatic feeder-

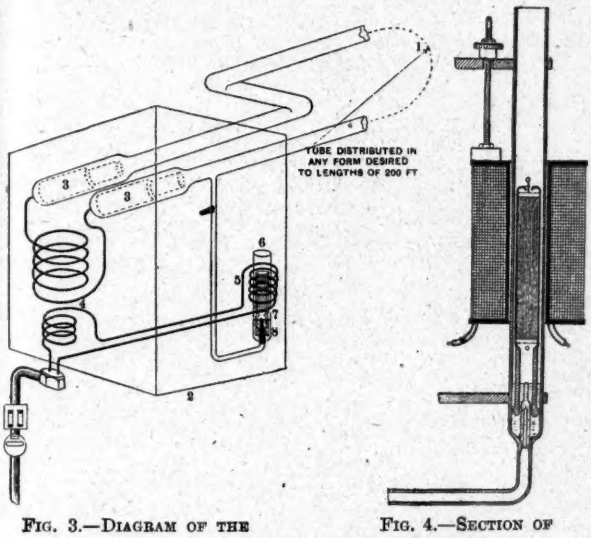


FIG. 3.—DIAGRAM OF THE MOORE LIGHT SYSTEM.

FIG. 4.—SECTION OF FEEDER VALVE.

valve, and fig. 3 shows its relation to the rest of the system in the apparatus-box.

The absorption of the gas increases the conductance of the tube, so that the current gradually rises; this property supplies the controlling factor. Connected to the main tube by a small branch is a vertical tube $\frac{7}{8}$ in. diameter, the lower end of which is sealed by a small carbon plug covered with mercury. A movable glass tube concentric with the plug dips into the mercury; its upper end is filled with iron wire, and is surrounded by a solenoid in circuit with the primary of the transformer. When the current in the latter rises, the inner tube is pulled upwards, lowering the surface of the mercury, and thus exposing the tip of the carbon plug, which is sufficiently porous to permit a minute quantity of air or other gas to diffuse through it into the vacuum tube. The position of the solenoid is regulated by a screw and nut. Normally the valve "opens" for about one second in every minute, allowing the tube, as it were, to breathe. When a nitrogren tube is used, the air with which the tube is fed is drawn through a small iron cylinder containing a piece of phosphorus, while a carbon-dioxide tube is provided with a small CO_2 generator which acts only when the tube requires feeding.

The tubes are used in lengths of 40 to 220 ft. They are easily erected, in lengths of 8 ft. 6 in., being sealed together in place; each joint takes only about two minutes in the making. The ends of the tube contain graphite electrodes.

The power-factor of the system is about 65 per cent., but can be raised to 84 per cent. by proper adjustment.

One of the greatest advantages of the Moore tube light is the low intrinsic brilliancy of the source of light; compared with other sources, the Moore tube (at 12 hefners per foot) has a brilliancy of 0·66 hefner per sq. in., while the Cooper-Hewitt mercury-vapour lamp gives 19, incandescent filaments 250, Nernst glowers 600, and the arc crater 10,000 hefners per sq. in. The intrinsic brilliancy of the Moore tube, moreover, can be varied from 0·33 to 2·0 hefners per sq. in. As there is no intensely brilliant source of light to deal with, it is not necessary to conceal the source in order to prevent dazzlement, so that there is no loss of light from this cause. In this respect the Moore system is unique, and approaches more nearly to the ideal than any other system.

[NOTE.—The hefner unit = 0·913 British standard candle.]

NOTES UPON THE NEW PATENTS AND DESIGNS ACTS.

BY W. P. THOMPSON & CO., Chartered Patent Agents,
322, High Holborn, London.

THE Patents and Designs Acts passed this year contain several new provisions which will be of importance to engineers and manufacturers, and it may be useful to briefly indicate the scope and effect of these provisions. The Patents and Designs Amendment Act (7 Edw., 7 Ch. 28) contains all the new enactments, and these are incorporated with the provisions of all older Acts, as far as the latter remain in force, by a "Consolidation Act" (7 Edw., 7 Ch. 29) which revokes practically all existing Patents and Designs Acts, including the first one above mentioned, so that the "Consolidation Act" will be the one law governing the granting and exercise of patents for inventions and the registration and use of registered designs from January, 1908, onwards, when the new Act comes into force.

Joint Applicants for Patents.—It is now provided that, in the absence of definite agreements to the contrary, co-patentees shall have equal rights in the use of the invention patented, and each can work it independently without accounting to the other co-patentees for the profits he makes thereby; but one co-patentee cannot grant licenses to other parties without the consent of the other co-patentees.

Patents of Addition.—At last the law has provided for the issue of patents of addition on substantially the same conditions as have obtained for many years past in most other civilised countries. A patent of addition will be granted for any proper development of the original invention; there will be no renewal fees on the patent of addition, but it will be appended to, and will expire with the original patent. Hitherto, of course, it has been necessary in this country to take out separate independent patents for developments of inventions made after the original patent was obtained.

Refusal of Comptroller to Grant Patents.—Hitherto, if the examiners found on investigation that an invention had been wholly anticipated, the Comptroller of the Patent Office was still bound to seal a patent to the applicant if the latter wished for it, although reference might be directed on the specification to the anticipating patents. Now, the Comptroller is empowered absolutely to refuse to grant a patent for an invention which has been shown to be wholly anticipated by prior British patents. Probably this power of refusal will be exercised only in very clear cases of anticipation, as it has been the practice hitherto, in opposition proceedings, for the Comptroller to give the applicant the benefit of any doubt which might exist as to whether an invention possessed patentable novelty.

Disconformity between Provisional and Complete Specifications.—If two or more concurrent provisional specifications for the same applicant relate to one invention and reasonable developments thereof, the Comptroller can allow the applicant to combine them all in one complete specification, on which a single patent will be granted. If a complete specification as filed within the six months' period after the provisional application, contains matter not foreshadowed in the provisional, the Patent Office may treat the added matter as a new application filed on the day of filing the complete specification, and if the added matter is really a development of the original invention, it can apparently be included in the one patent with the original matter; if, however, the added matter is a separate invention it will require a separate patent. In any case the applicant will only be given priority of rights in the further development, or the added matter as from the day on which full disclosure of it was made to the Patent Office. If the Patent Office examiners once pass a complete specification, the patent cannot be attacked afterwards on the ground of disconformity between the provisional and complete specifications, if such disconformity should be thought to exist. This provision applies to existing patents, so that no patent can be upset after January next on the ground of disconformity. A curious point may arise under this section; where an existing patent could have been invalidated by action in the courts on the ground of disconformity between its provisional and complete specifications, the patent will not be invalid on this ground after January next, and it is a question whether the patent would be held to have been valid from its commencement, so that action could be taken against infringers who had assumed up to the present that they could rely upon the disconformity to resist any action for infringement.

Oppositions to Grant of Patents.—The grounds of opposition are slightly extended by the new Acts, and provision is made for what is equivalent to "opposition" after the grant of the patent, at any time within two years from the date of the patent application. Parties interested in prior patents for the same invention, or who have had an invention stolen from them by the applicant, can thus either oppose the grant of the patent in the old way, or can apply to the Comptroller to have the patent annuled or restricted at any time within the two years period. This provision should be of value; after a patent was granted it could only be attacked

hitherto by action in the courts, the expense of which was often prohibitive, whereas the new enactment will provide a comparatively cheap method of stopping patents which have been wrongly or unjustly obtained.

Manufacture Abroad.—There are extensive provisions empowering the Comptroller to annul a patent after four years from the date of the application if it is worked largely or exclusively abroad when it might be worked in this country. There are also improvements in the procedure for obtaining compulsory licences from patentees when manufacturers or traders are unfairly prejudiced by the refusal of a patentee to grant such licences.

Restoration of Lapsed Patents.—Hitherto patents which had been accidentally allowed to lapse through failure to pay renewal fees within the proper period, or certain fixed extensions thereof not exceeding three months, could only be resuscitated by a special Act of Parliament. Now the Comptroller of the Patent Office is empowered to resuscitate lapsed patents, if timely application is made to him and adequate proof is brought forward that the lapsing was unintentional.

Unfair Contracts on Sale or Licensing of Inventions.—It is made illegal by the new Acts to impose without option unfair conditions on the purchaser or licensee requiring him to obtain certain articles, patented or otherwise, from the patentee or other specified party; and existing contracts containing such provisions can be determined on three months' notice by either party, subject to the payment of suitable compensation if hardship is involved in the termination of the contract. The Act also provides that all existing contracts as to licensing patented inventions shall be determinable upon three months' notice by either contracting party as soon as all the patents involved in the contract shall have expired, but arrangements are also made for compensation being paid if the termination of the contract imposes hardships on either party.

Exemption of Innocent Infringers.—Hitherto in an action for infringement, the infringer could not escape from paying damages by pleading ignorance of the patent under which he was being sued. Now it is provided that this excuse of ignorance of the plaintiff's patent shall be a valid one; further, it will not be sufficient intimation that an invention is patented to mark the articles with the word "Patent" alone, but the number and year of the patent must be given also. Manufacturers should be careful in future, therefore, to mark all patented articles fully, as above indicated, in order that they may have good grounds for taking action against infringers.

Costs of Parties to Oppositions.—The Comptroller of the Patent Office is now empowered to award costs to either party, when reasonable claim can be made for such costs, as a result of any opposition proceedings before him. Hitherto only the Law Office could award costs on appeals to him from the Comptroller. The Comptroller and law officer can also require parties resident abroad to give security for costs before they will proceed with any opposition in which such parties are concerned, and if the security is not given, the opposition is regarded as abandoned.

Misuse of the Title "Patent Office."—Hitherto many patent agents have labelled their offices "Patent Office" in large letters, or have used this title on their stationery, &c. This practice is now made illegal, and the title "Patent Office" is made to apply exclusively to the Government Patent Department. This provision has long been wanted, as many innocent inventors have walked into agents' offices believing them to be the Government office.

Design Registrations.—The new provisions as to registered designs, as far as they are likely to interest readers of this paper, are as follows:—

Design registrations formerly lasted only five years. The registration can now be renewed at the end of this period for a further five years, and at the end of this latter period for a final five years, making a total possible life of 15 years for design registrations.

The enactment that a design registration became void if any articles sold under it were not marked with the contraction "Regd.," followed by the number, is now repealed, and the proprietor is only warned in the new Act so to mark his goods if he wishes to make sure of obtaining damages from infringers.

Similar provisions are made for the cancellation of design registrations as for revoking patents if the articles are manufactured largely or entirely abroad.

Fines are imposed for continuing to mark articles as if they were still protected by design registration, after the registration has expired.

Other new provisions of minor importance varying the procedure in patent and design applications, &c., are not given here, as they would probably not be of much interest, but all will be found in the copies of the Acts, which are published at a cost of a few pence each at Messrs. Eyre & Spottiswoode's, and are obtainable from them either directly or through any bookseller.

New Field Telephone.—Experiments have recently been carried out by Lord Kesteven, Colonel commanding the Lincolnshire Imperial Yeomanry, with a field telephone and telegraph instrument devised by Lieut. Medhurst, of the Australian Corps of Signallers, Tasmania. The weight of the complete apparatus is under 3½ lb., and it can be used over considerable distances through wire fences, or lightly insulated wires.

New Electro-Technical College at Grenoble.—The President of the Chamber of Commerce at Grenoble has given the city an estate valued at £24,000, on condition that it is used as a site for an electro-technical college.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

19,602. "Improvements in depolarising mass." J. T. Szek. September 2nd.

19,626. "Improvements in electric locking apparatus for railway signalling." Siemens Bros. & Co., Ltd. (Siemens & Halske Actiengesellschaft, Germany.) September 2nd. (Complete.)

19,670. "Friction permeameter for testing magnetic materials." W. H. F. Murdoch and A. T. J. Kersey. September 3rd.

19,672. "Improvements in metallic filaments or the like for electric glow lamps, and in the method of making same." Ges. fur Verwertung Chemischer Produkte m.b.H. (Date applied for under Patents Act, 1901, August 2nd, 1907, being date of application in Germany.) September 3rd. (Complete.)

19,697. "Improvements relating to the suspension of electric motors for electrically-propelled vehicles." K. V. Kando. September 3rd.

19,699. "Improvements in and relating to signalling and like systems." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, September 3rd, 1906, being date of application in Germany.) September 3rd (Complete.)

19,708. "Improvements in or relating to contacts for electric controllers or switches." A. White. September 3rd.

19,734. "Improvements in or connected with electric arc lamps." O. Gross. September 4th.

19,738. "Improved means for controlling mechanism operating valves, electric switches, rheostats and the like." W. J. Poole. September 4th. (Complete.)

19,784. "Improvements in and relating to switch mechanism for electrical signalling and like systems." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, September 5th, 1906, being date of application in Germany.) September 5th. (Complete.)

19,786. "Improvements in and relating to dynamo-meters." E. W. Kay. September 4th.

19,789. "Variation of candle-power in electric lamps." J. R. Quain and C. L. True. September 4th.

19,794. "Improvements in detectors for wireless telegraphy." Gesellschaft fur Drahtlose Telegraphie m.b.H. (Date applied for under Patents Act, 1901, September 8th, 1906, being date of application in Germany.) September 4th. (Complete.)

19,800. "Improvements relating to dynamos especially applicable for exploding electric igniters." H. W. Lake. (Fabrik Elektrischer Zünder G.m.b.H., Germany.) September 4th. (Complete.)

19,805. "Improved device for transferring drawings, manuscripts and the like by electricity." K. Wackermann. September 4th. (Complete.)

19,808. "Improvements in incandescent electric lamps." W. E. Barras and G. Weddell. September 4th. (Complete.)

19,855. "Improvements in electrical switches." T. L. Boyden. September 5th. (Complete.)

19,856. "Improved means for connecting alternating current generators to their prime movers." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke, G.m.b.H., Germany.) September 5th. (Complete.)

19,875. "Electric hot water radiator for heating buildings or the like." C. G. Nobbs and C. G. Nobbs, jun. September 5th. (Complete.)

19,882. "Improvements in and relating to dynamo-electric machines." British Thomson-Houston Co., Ltd., and F. H. Clough. September 5th.

19,993. "Improvements in and relating to protective devices for alternating electric current distribution systems." British Thomson-Houston Co., Ltd., R. C. Clinker, E. B. Wedmore and J. E. Woodbridge. September 5th.

19,891. "Improved automatic safety device for overhead electric lines." F. E. Bourdil. (Date applied for under Patents Act, 1901, September 7th, 1906, being date of application in France. September 5th. (Complete.)

19,907. "New or improved portable electric vulcanising apparatus." J. Hay, H. R. Cooper and W. H. Lindsay. September 6th.

19,926. "Electro-magnetic separators." W. L. Spence. September 6th.

19,945. "Improvements in or relating to variable candle-power electric incandescent lamps." T. N. Atkinson and Atkinson's Patents, Ltd. September 6th.

19,954. "Improvements in and relating to connections for the windings of dynamo-electric machines." British Thomson-Houston Co., Ltd., and K. A. E. Tunelli. September 6th.

19,955. "Improvements in and relating to electric power transmission systems." British Thomson-Houston Co., Ltd., and A. A. Pollock. September 6th.

20,005. "Improved ceiling rose for use in connection with electric lighting." S. Johnston. September 7th.

20,040. "Improvements in the regulation of continuous-current electric motors." P. B. Down and E. Vyse. September 7th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Suspension of Wires, Cables, and the like for Electric Traction. A. Pringle. 10,994. May 10th.

Wireless Telegraphy and Telephony. E. R. Clarke and M. Barr. 11,114. May 11th.

Controlling Apparatus for Shunt-wound Motors for driving Machine Tools. A. Wichler and G. Rennert. 15,839A. July 12th. (Date applied for under Rule 5, Patents Rules 1905, July 12th, 1906.)

Electricity Supply Systems. G. Wilkinson. 17,786. August 8th.

Electrical Conductors. J. C. Fuller and G. Fuller. 18,329. August 15th.

Thermal Electric Contact-Makers. N. M. Ogle. 18,336. August 15th.

Field Magnets for Dynamo-Electric Machines. Bruce Peebles & Co. and J. L. La Cour. 18,532. August 18th.

Apparatus for Signalling or Communicating Messages or the Like, or displaying Advertisements, by Means of Electric Lamps. C. F. Heywood. 18,575. August 18th.

Methods of Manufacturing Conductive Filaments and other Incandescing Bodies for Use in Electric Lamps or other Apparatus. British Thomson-Houston Co. (General Electric Co., United States.) 18,745. August 21st.

Manufacture of Electric Conductors from Refractory Metals and Materials Suitable for Use in Electric Lamps, Furnaces, and other Apparatus. British Thomson-Houston Co. (General Electric Co., United States.) 18,749. August 21st.

Electric Incandescent Lamps. A. Lederer. 18,874. August 23rd.